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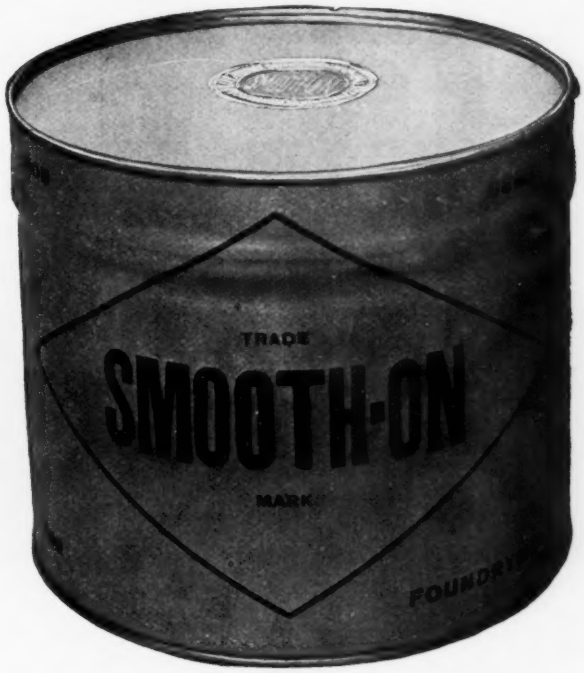

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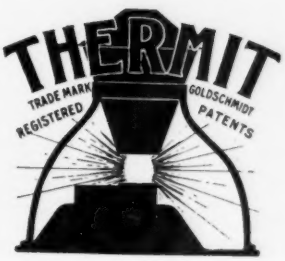

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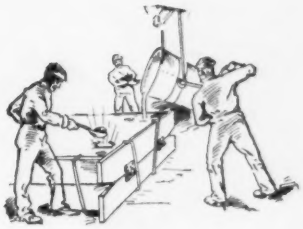

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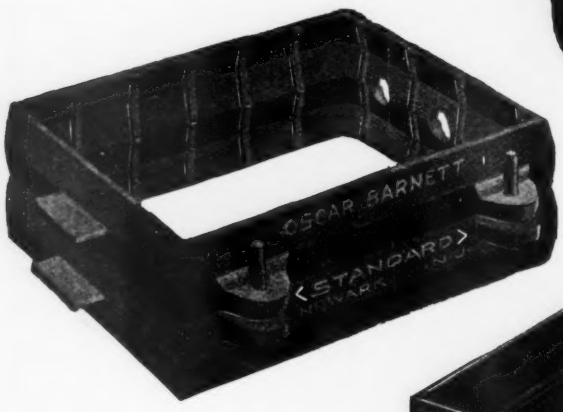

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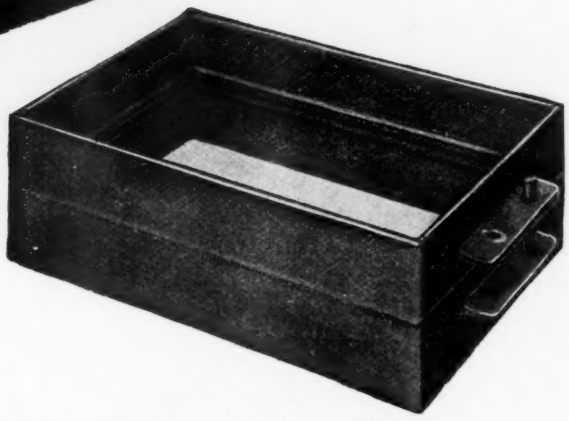

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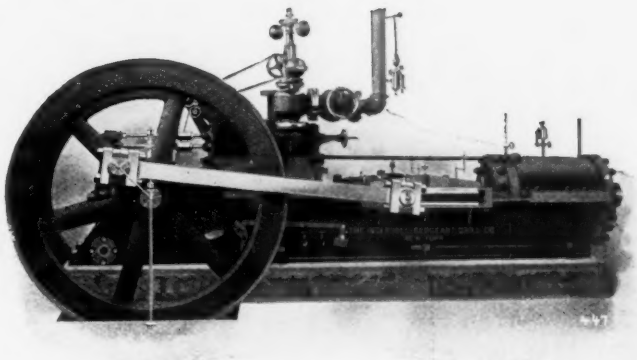

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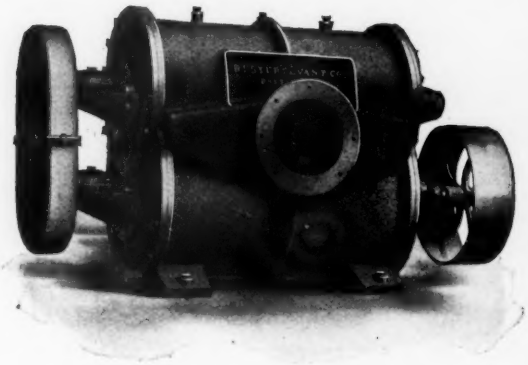

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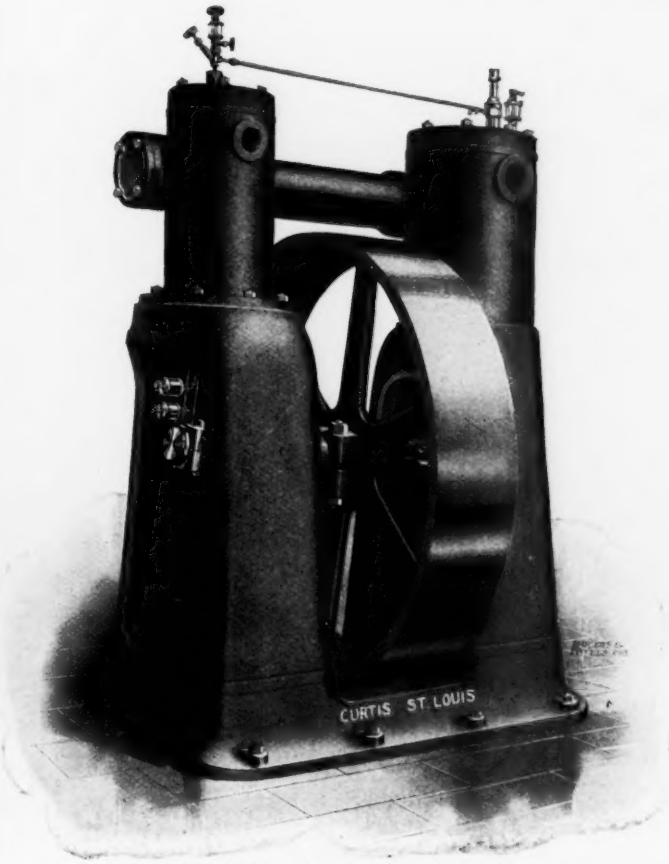

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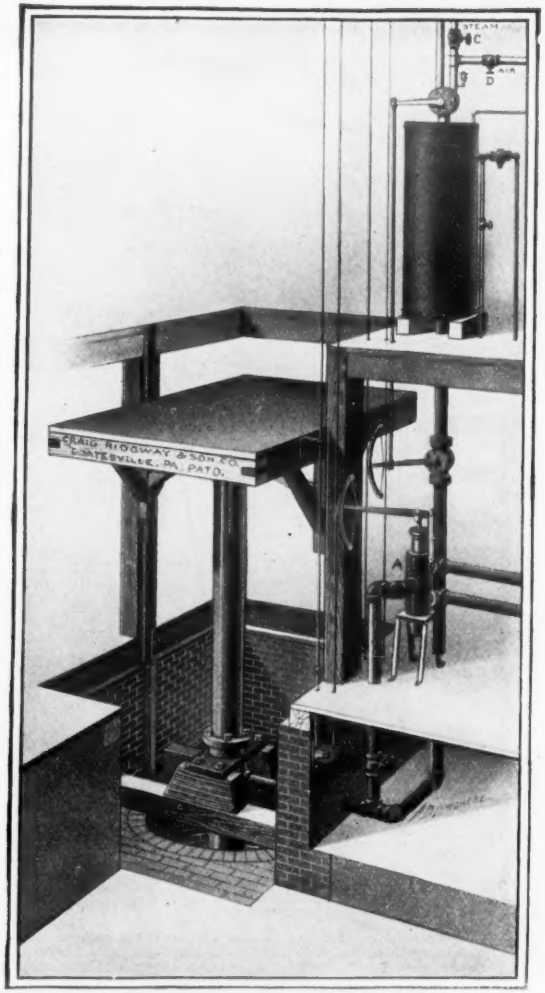

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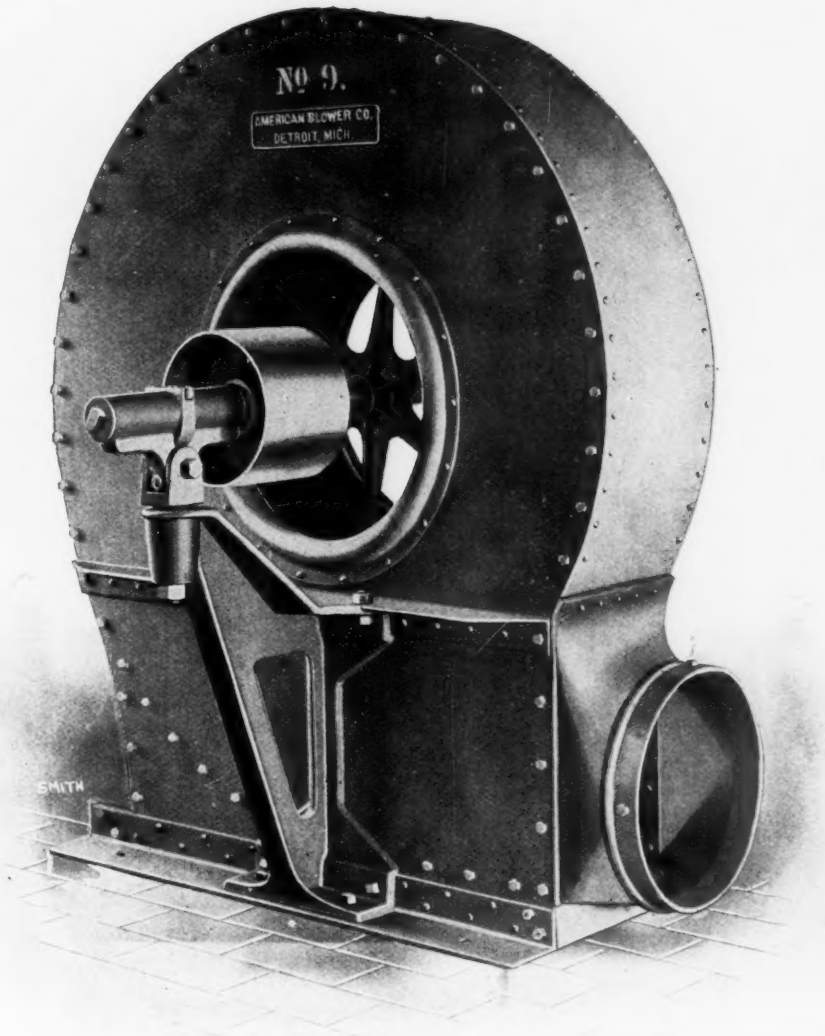

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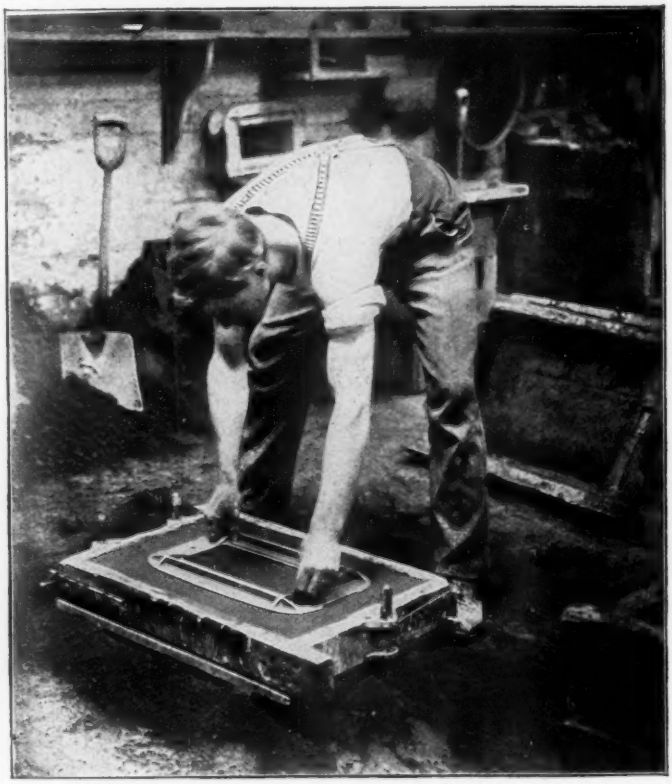

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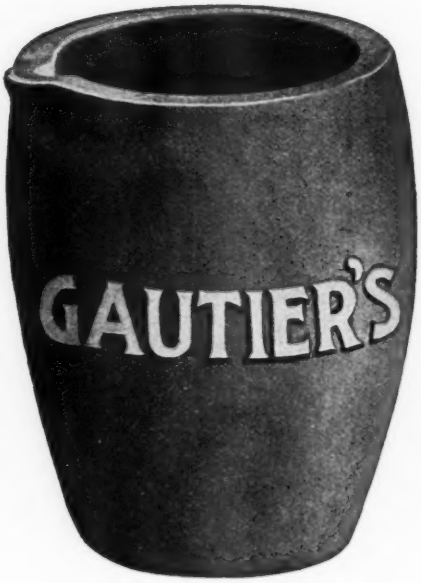

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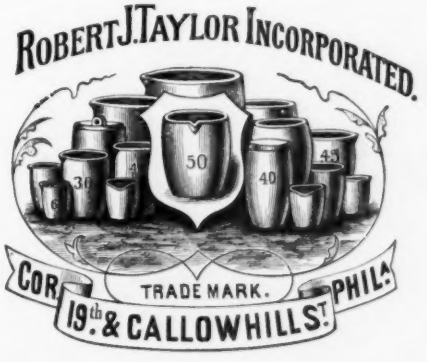

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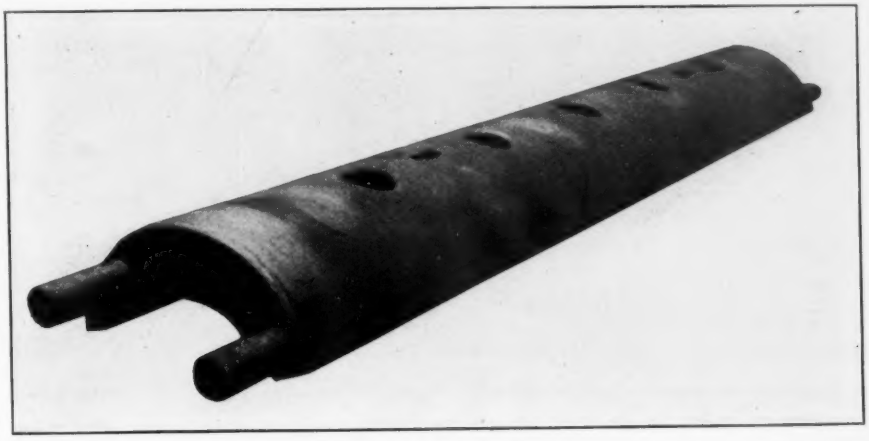

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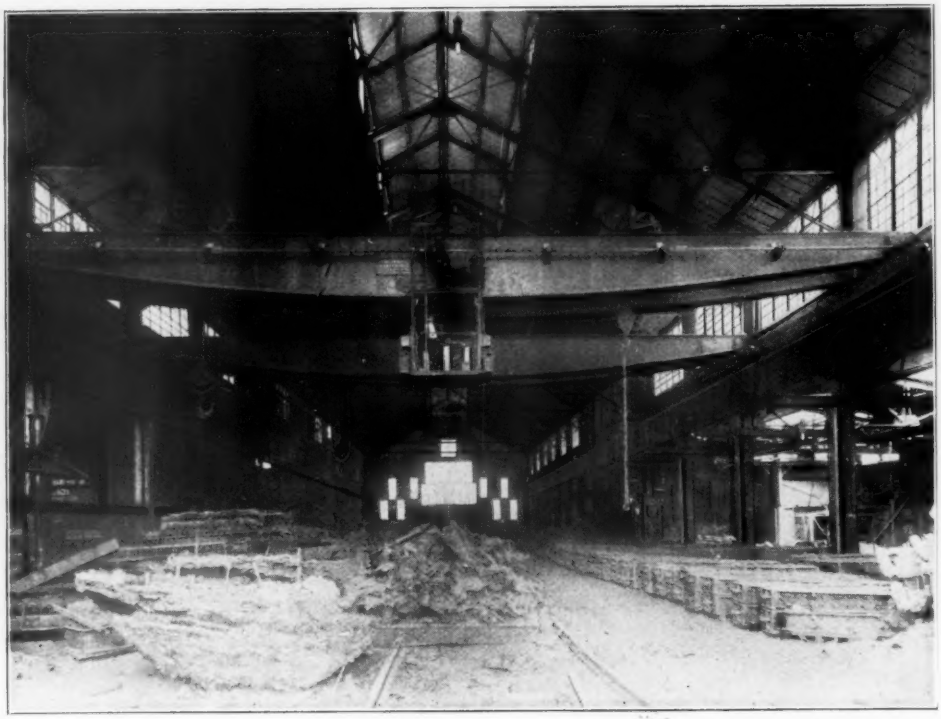

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THE FOUNDRY

Vol. 28, No. 4. *CLEVELAND, OHIO, JUNE, 1906.* *Whole No. 166*

The Foundry of the H. W. Caldwell & Son Co., Chicago.

The H. W. Caldwell & Son Co., of Chicago, is now operating its own foundry. This installation became necessary by the rapid increase in its business since the company acquired the entire line of gear patterns and power transmission machinery patterns, as well as the gear molding and gear cutting machinery of the Walker Co., Cleveland, Ohio. In addition to its ordinary requirements in the way of castings, the Caldwell company has of late made a specialty of large pulleys, band wheels, fly wheels and rope sheaves; and the difficulty experienced in getting castings of the right grade of metal, and at the right time, made a foundry under its own management an absolute necessity.

The company's plant, which includes besides the foundry, a machine shop and rolling mill, is located on Western avenue, between Seventeenth and Eighteenth streets. Railroad connection is provided by a spur track of the Chicago Junction railway, which passes through the foundry building to the south end of the machine shop, where it connects with the main line. Raw material is brought in on this track, it being also used for transporting heavy castings to the machine shop, these being loaded on to cars by a traveling crane. In the latter, they are unloaded by another traveling crane and placed in the tool where the work is to be performed.

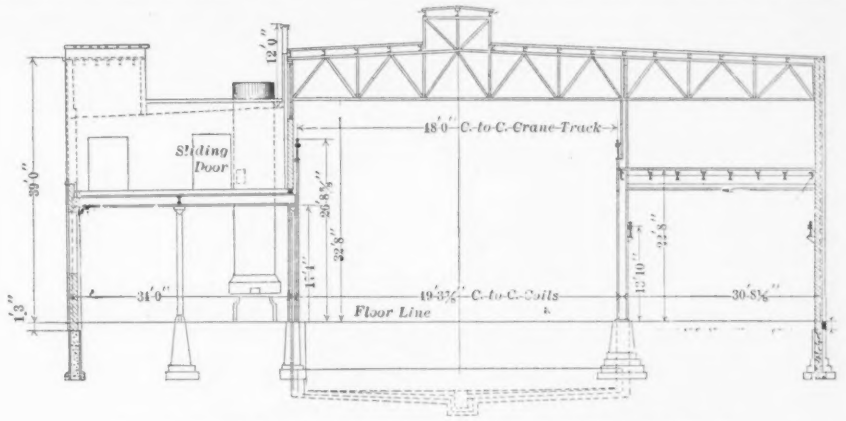


FIG. 2 CROSS SECTION OF FOUNDRY, H. W. CALDWELL & SON CO.

Anti-friction trucks running on industrial tracks transfer the smaller castings directly to the machine shop.

The foundry is 114 feet wide by 185 feet long, and is divided into one central and two side bays. The west bay is one story in height and 33 feet wide; the east bay is 28 feet wide in the clear. The middle bay contains the main casting floor and is nearly 50 feet wide from center to center of main columns. The building is provided with a perfect system of industrial tracks and transporting equipment,

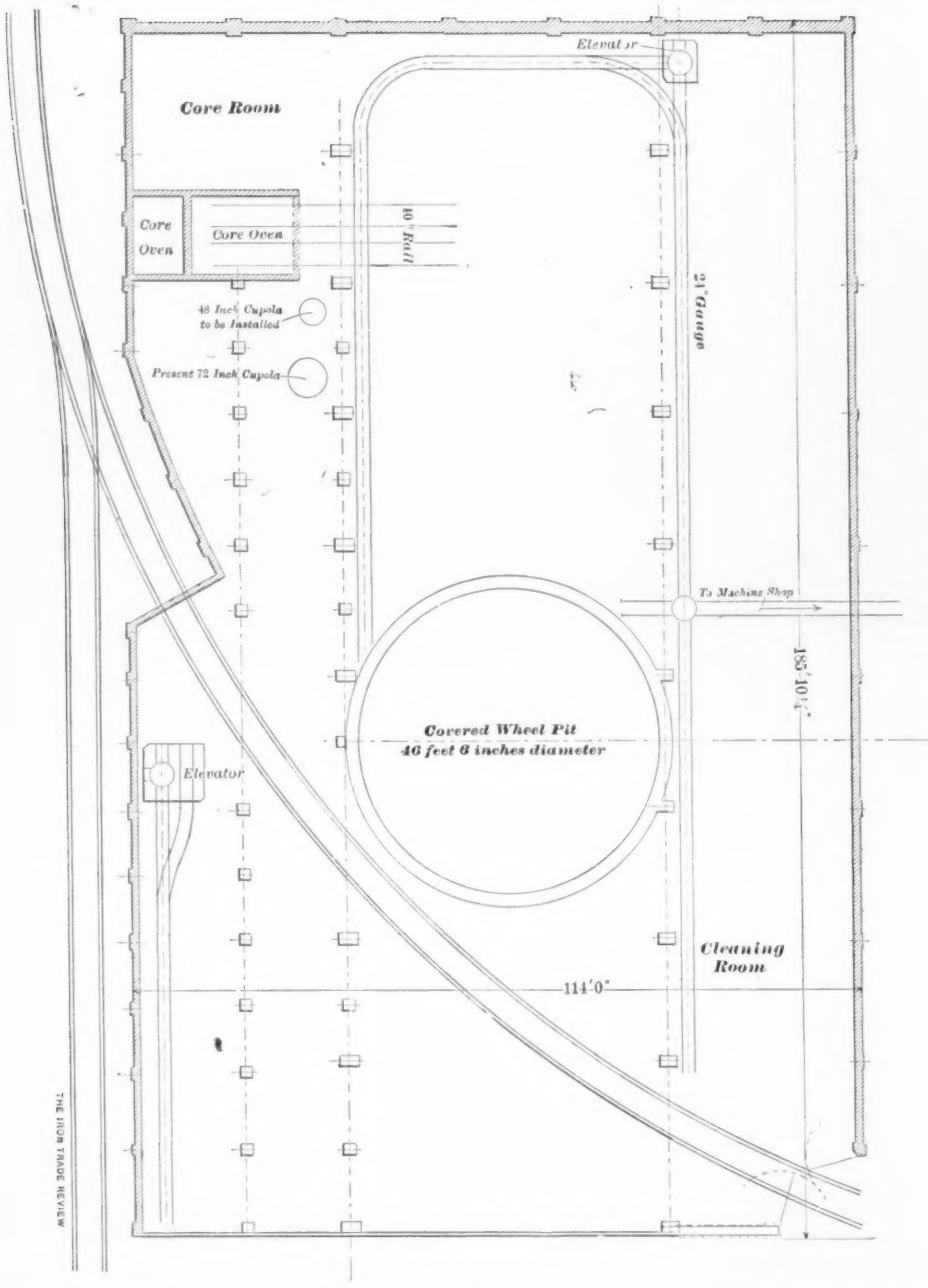


FIG. 1. PLAN OF FOUNDRY, H. W. CALDWELL & SON CO.

which greatly facilitate the operation of the work as well as increasing the output of the foundry. The scarcity of room for a foundry having the capacity desired by the company was the greatest problem confronting the designer, and to provide ample floor space for molding, many novel ideas were adopted in the construction of the building and in the location of the equipment. Most noteworthy among these is the gallery in the east bay where about 30 molders are exclusively employed on bench work, and in which also is located the carpenter shop. This gallery runs the entire length of the

bay and is nearly 30 feet wide. It is served with hot metal by truck ladles running on an industrial track extending from the cupola in the west bay to a 3,000-pound Reedy elevator, located in the northwest corner of the east bay, an arrangement clearly shown in the ground plan of the foundry. The turn table in the elevator car facilitates the transfer of the loaded truck to the industrial track running the entire length of the gallery.

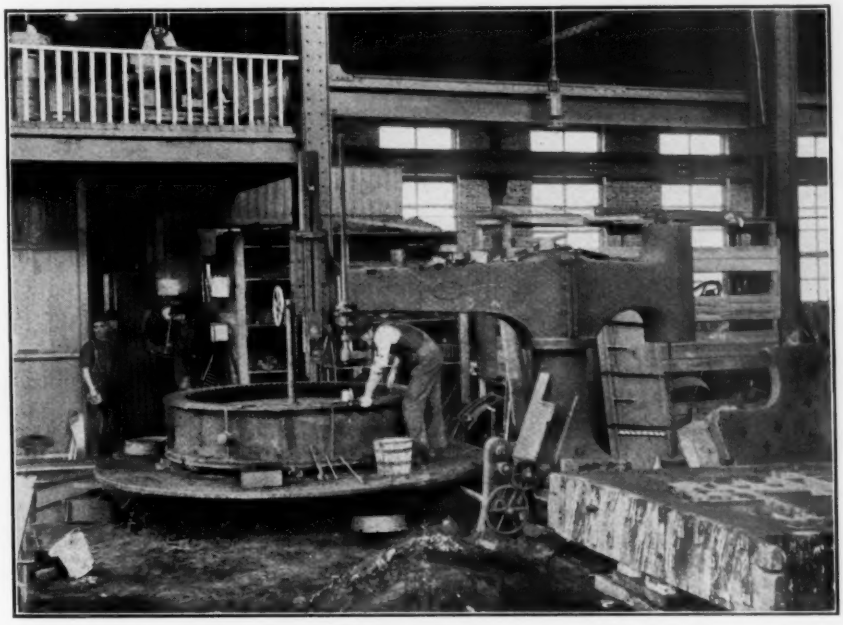


FIG. 4. GEAR MOLDING MACHINE IN FOUNDRY.

Another space-saving arrangement is the provision that has been made on the level of the charging floor for storage capacity. The roof of the west bay is used for the same purpose, this being made of reinforced concrete and proportioned for a load of 600 pounds per square foot, with a factor of safety of four. About 80 feet of this space is used for a charging floor, being in turn covered by another roof. The remaining portion of the main roof, 64 feet in length, is used simply for a storage room, and has a capacity of 900 tons. Industrial tracks run the entire length of the roof, being connected at the farther ends with turntables. The roof is served by a Reedy electric elevator of 6,000 pounds capacity, with a speed limit of 75 feet per minute. A railroad track runs alongside the elevator at the bottom of the shaft, and stock can be taken from the cars and elevated to the storage room or the charging floor with only one handling.

FIG. 5. LADLE TRUCK, AND ELEVATOR SHOWING TURNTABLE.

FIG. 3. INTERIOR OF FOUNDRY, H. W. CALDWELL & SON CO.

The main floor of the west bay contains the core room, core ovens and cupola. Provision has been made for the installation of two cupolas, one having a 72-inch shell, and the other a 48-inch shell. At present, a 72-inch Whiting cupola, 45 feet high, is the only one installed. This is located south of the core ovens. It is supplied with a No. 6 down draft Roots blower, driven by a 50 horsepower Bullock motor, to which it is directly geared. This

FIG. 6. GALLERY FOR BENCH MOLDING, FROM ELEVATOR.

motor is so controlled by a Cutler-Hammer controller that air pressures from 9 to 16 ounces per square inch can be obtained at will. This flexibility of control has already proven of great advantage. The blower is located on a platform about 8 feet high in the clear above the main floor and directly behind the cupola. The blast pipe leading thence is so arranged that con-

FIG. 7. GALLERY FOR BENCH MOLDING, LOOKING TOWARD ELEVATOR.

FIG. 7. CUPOLA AND CORE OVENS, H. W. CALDWELL & SON CO.

nections can be made to the 48-inch cupola when it is installed, and the blast may be throttled at will.

The core ovens are of the down draft type, the damper in the flue near the top of the oven being used only to start the fires. The flame from the fires passes up through a checkered fire brick arch, the heat rising to the top of the oven whence it gradually descends as air is drawn out through the bottom. These underground flues are made of 18-inch tiling.

The main feature of the middle bay is a wheel pit, 46 feet, 6 inches in diameter, which is filled with sand up to a point within two or three feet of the surface. It is shown in Fig. 1. The gear molding machine, shown in Fig. 4, is also located in this section. A 20-ton Pawling & Harnischfeger traveling crane, with a 50 per cent overload capacity, having a 5-ton auxiliary hoist, spans the middle bay. The crane girders are 48 feet apart, center to center, and are proportioned to sustain two 20-ton traveling cranes.

A half-story has been built in the north end of the east bay and the men's wash and toilet rooms located in it. Beneath is the foundry office and store room where all patterns for the day's work are brought in and placed on racks. The floor of the east bay is used for molding and for cleaning castings. The machine shop adjoins it, the two being connected by an industrial track. A 5-ton electric traveling crane serves the foundry floor. Pneumatic tools are largely used, air being supplied by an Ingersoll-Sergeant compressor. The compressor is located in the power house, the air being piped to the chipping room and sand beds. A portable pneumatic riddle is used for sifting the sand, and this also is supplied with air from the power house. Two exhaust tumbling barrels, a Norton double emery wheel and a portable grinder also form part of the equipment of the cleaning room. Two 10-horsepower motors, located on bracket platforms in the east wall of the foundry furnish power for the machinery in the cleaning room as well as for the wood working tools in the flask depart-

ment at the south end of the gallery floor above.

Fig. 1 shows the arrangement of standard and industrial tracks in the plant. The spur track leading to the property is of standard gauge and is plainly shown in the cut. The industrial tracks are 24 inches gauge and their location on the ground floor is also clearly shown. The track in the east gallery is immediately above the through the gallery floor, northward, and from branches located at each panel point hot air is blown across the middle and east bays. Arc lights located at the center of each panel, along the lines of columns dividing the three bays furnish ample artificial illumination, while plenty of natural light is provided by numerous windows, as shown in the illustrations. Hydrants, bell traps and cess pools are

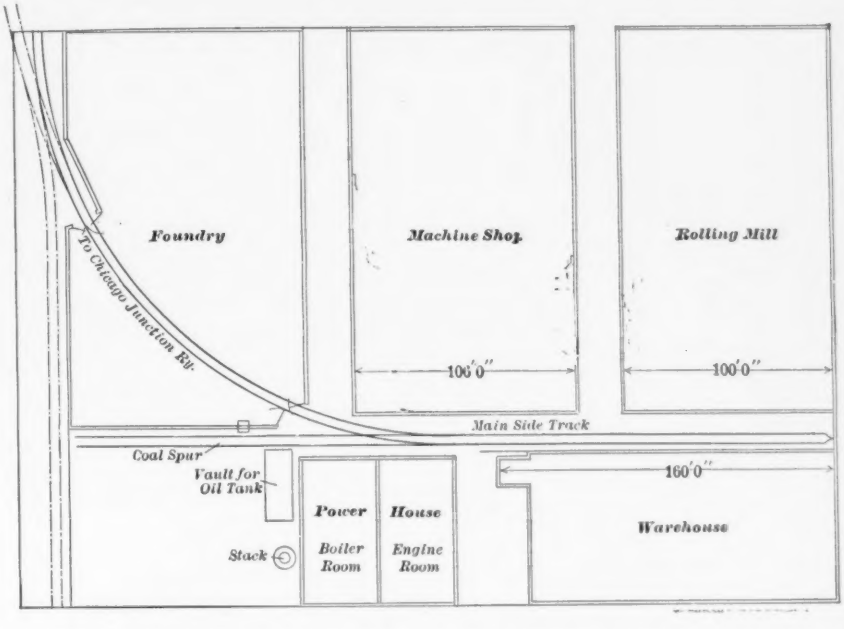


FIG. 8. PLAN OF ENTIRE PLANT, H. W. CALDWELL & SON CO.

track in the east bay. Tracks on the charging floor are shown in the lower portion of the cut. The heavy crane ladles are picked up by the 20-ton crane and the lighter crane ladles rest upon anti-friction trucks, and run north and east from the main bay and south on the main floor of the east bay, where they are picked up by a 5-ton crane.

Special attention has been given to the heating, sanitary and lighting arrangements of the foundry. The building is heated by a blower system consisting of vertical engine fan and steam coils. This blowing system is located on an elevated platform in the east gallery, and the galvanized iron piping leading thence extends downward located every 40 feet along each side of the middle bay, the cess pools being drained by 6-inch sewers connecting with the sewerage system of the city. Hose bibs at various points furnish a convenient means of tempering the molding sand.

The power required by the foundry, as well as for the other departments of the plant, is furnished from one 100 kilowatt belted generator, and, one 100-kilowatt and one 50-kilowatt direct connected generators located in the engine room of the power house. Direct current is furnished at 220 volts.

The plant was designed by W. L. Stebbings, engineer, 1110 Monadnock Block, Chicago, who also designed the machine shop, power house and rolling

mill of the company. The output of the foundry varies greatly from day to day because of the unusual variety of work required.

MODERN FOUNDRY CONSTRUCTION.[1]

BY DAVID TOWNSEND.

I presume there are still a great many old-fashioned foundries around the country districts today, but compressed air, electricity and the traveling crane have revolutionized foundry methods to such an extent that it is a very poor plant indeed that cannot show some advance towards the perfection which we all desire and think we know.

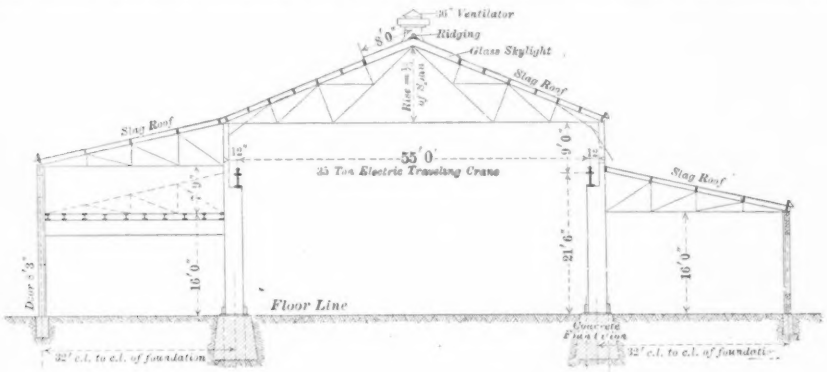


FIG. I.—CROSS SECTION OF STEEL FRAME FOUNDRY BUILDING.

Let us consider for a short time, the various points which are absolutely essential to a thoroughly modern shop. Where a new foundry building is under consideration and its size or capacity has been fixed upon, the other essential parts are: Materials of construction, movements of production, storage of raw and finished materials, light, power and heat.

Taking it for granted that there are no complications, as to size or location of site, the first thing to be considered is proposed amount and kind of output and the floor space which it will occupy. This ranges all the way from 5 to 15 pounds per day of 10 hours for each square foot of actual molding space occupied, according to the product to be made. This, of course, does not include any core room, core oven or cupola space.

Strange as it may seem, the heavier the work, the less pounds output per square foot per day can be produced, because on large pieces molded in the floor, such as engine beds, lathe beds, etc., a long time is taken to mold and prepare for pouring, and to subsequently cool, and, although the weight may be considerable, the average in pounds per foot per day is very small. The largest output is obtained by molding machines and snap flask work, where continuous or multiple pouring is practiced and the molder does nothing but mold, his heat being poured off almost as made, by an expert gang of men who do nothing else.

The class of work to be made and the daily output having been determined, the size of building and materials of construction are the next important items to consider and here is where the question of cost first appears as an important factor. We all naturally want the very best for the least money, but when the range of cost runs from 80 cents per square foot of floor space covered up to $1.50 per square foot, there is considerable room for a choice. At one end of this range we have the old brick or skeleton iron frame structure with wooden sides and roof, and at the other, an absolutely fire proof structure made of steel and concrete throughout.

I have developed in my own practice

[1] A paper read before the Philadelphia Foundry Foremen, Feb., 1906.

a construction which is practically fireproof, except the roof and have had an experience with the same from the insurance standpoint; the worst that happened being a partial destruction of the roof and all of the glass skylight which was cracked by the heat. This fire was caused by the exploding of a mold for a 30-ton anvil block, which shot several tons of liquid iron against the underside of the roof and caused a fire which damaged the glass principally as stated.

My construction consists primarily of a steel frame, self-contained structure with nine-inch brick or four-inch concrete curtain walls, ordinary glazed sash, and a steel truss with a wood roof covered with four-ply slag and containing glass skylights its whole length. A cross section through the building is shown in Fig. 1.

This construction is being generally adopted for iron foundries in this country, and, of course, has many advantages and some disadvantages; the latter connected principally with the subject of storage and movement of raw materials and general arrangement of storage yard for iron and fuel.

The arrangement most favored in Europe is one which has the cupolas, furnaces, core rooms and sand storage in the center of the building as shown in Fig. 2. This style of construction has also been adopted very largely in this country for steel foundries. In these plants, one whole side or floor is used for molding; the molds then being put into the core ovens and when dried are taken out on the other side onto the casting and cleaning floor. The core ovens are in the center bay and a very large sand storage space is obtained by utilizing the top of them for bins. This brings the new sand inside the foundry and in a position where it can be utilized for tempering or for new molds, without handling. In steel foundries, the furnaces are put on the outside of the general foundry construction, but where this type is used for iron foundries, the cupolas are placed in the center bay with spouts to deliver iron into either side and the space over the core ovens, core rooms, store room, etc., can be used for storage of sand, coke and iron.

Aside from a proper selection of materials for construction and general arrangement, the most important thing to be provided is good light. We have all suffered in various degrees from the want of good light, and know the inconvenience of always having a hot, smoking oil lamp under our noses to see into dark corners of the mold.

To my mind no other item about a foundry will give the financial return that is to be had from a strong natural light. Aside from the fact that daylight costs nothing and artificial light of any kind is expensive, the cheerfulness of disposition and general temper of a shop are very much improved by proper natural illumination. The inside of the foundry should be nearly as light as an open field and it can be made so if a proper design and construction is adopted.

In trying to get as much light as possible, care must be taken, however, not to get too much in the shape of direct sun's rays, which may be very agreeable in winter, but exceedingly uncomfortable in summer. This can always be overcome by a careful study of the location of the foundry and its relation to the course of the winter and summer sun. The side bays should be just as well lighted as the central or runway bay, as all the snap and machine molding is done here and good light and ventilation is essential to rapid and accurate work. Skylights, transoms and side windows form the principal means of illumination, but this may be materially increased by making the gable ends above the runway in the central bay entirely of glass at both ends of the foundry.

Where concrete curtain walls are used for an outside covering, the windows may be much larger in area than where brick is used as a curtain wall; on account of a certain size of brick construction being necessary for safety against cracking or falling down.

Next to natural light comes the question of power and it is now generally admitted that electricity fulfills all the conditions to perfection. It is the most

economical when properly applied and can be quickly carried to any given point by wires without any intermediate transmission machinery. I generally advocate a 220-volt current at the point of consumption, which would mean from 230 to 250 volts at the generator. This voltage is now used almost universally and was adopted as giving the greatest latitude as to distance from the generator and size of the carrying wires, which means a considerable expense when the distance is great. I have advocated in some instances a 500-volt current to save copper where the distances were over 2,000 feet and have reduced this to 220 volts for lights, and for groups of machines or motors. In using electricity, especially in the foundry where perfect insulation is almost unattainable owing to the dust and moisture, it is wise not to be too saving of your wiring. A few hundred, or even thousand dollars, can easily be consumed in shut downs of the crane or long waits due to breakdowns in your main carrying wires. It has been my rule where possible to advocate carrying three separate lines of feed wires from the generator to the cranes, lights and miscellaneous power with separate switches and circuit breakers for each line. By this method you are not entirely shut down, except by an accident to your generating machinery and this is reduced to a minimum by using direct-connected sets of standard construction or duplicate generating sets where the size of the business allows of it. A pair of wires capable of carrying 10 horsepower should be put on each column in the foundry with a switch so that a wire can be quickly attached for use on special machines or for lights on the foundry floor.

For foundry lights, I advocate the incandescent arc with reflectors, rather than bunched incandescents, as the latter need constant attention. Individual incandescent lamps, which should always have a wire guard, can also be attached to the switch on the columns and used for dressing up deep molds.

Compressed air seems to be so well established in the foundry that it is now almost indespensable, but too many managers forget that it is the most expensive power that can be used, both on account of the original cost of the compressor and also from losses incident to its storage and transmission.

It would be well to remember that the best economy can be gained by a first class two or three stage compressor, ample storage tanks and above all extra large size for the distributing pipes, which reduces friction and saves in small reduction of pressure. All pipe lines should be occasionally tested with a steam gauge, leaving the pressure on all night and noting the drop. If the loss is excessive, you will save money by going over the whole line as the leak may be either in the joints or at valves and caps, I usually drop a feed pipe down from the main line at each column ending in a valve to which can be attached a hose for chipping or ramming hammers, hoists, sieves or molding machines. Eighty pounds at the

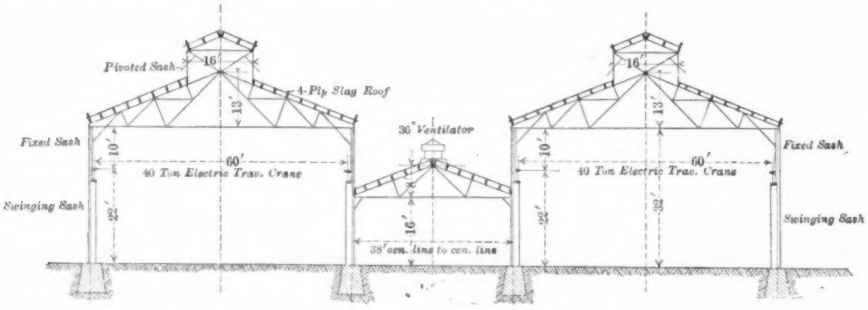


FIG. 2.—CROSS SECTION OF FOUNDRY BUILDING USED IN EUROPEAN PRACTICE.

storage tank is considered a standard for this kind of power.

Last, but not in any way least, is the problem of heat and ventilation. Where a supply of exhaust steam is available, the only economical and efficient plan for heating a foundry is by the blower system, which utilizes the waste steam from the engine and distributes the heat equally through the building. This system has the advantage that it may be turned into a cooling system in summer or even into a ventilating system during pouring time when the foundry is apt to become full of steam, dust and smoke from the ladles and molds.

I incline to a uniform temperature of 60 degrees for a foundry, as the work is more or less violent and a higher temperature is apt to be too exhausting.

OPEN-HEARTH STEEL CASTINGS.—VI.

BY W. M. CARR.

Basic Practice (Continued).

In charging cold stock about one half of the time required to work a fifteen to a twenty-ton heat is taken up in melting. As that interval advances the slag is increasing in volume and some changes in composition will take place in the first portions of the metals melted. The slag is more or less viscous with lumps of lime coming to the surface as it becomes loosened from the bottom. There is a foaming or bubbling in the slag caused by the CO_2 being liberated from the limestone and also by the action between the oxides of the slag and the carbon of the bath. As the lime continues coming to the surface it increases the basicity of the slag and with that condition there will be a rapid absorption of phosphorus from the bath.

The operator feels over the bottom of the furnace with a long bar to determine whether the bath is entirely melted or not. If no pasty masses are touched the bath is completed molten. A sample of metal is then poured into a small oblong mold, quenched and broken to study the fracture, the appearance of which indicates the carbon present and also whether there may be any phosphorus remaining. An experienced eye can readily read the carbon of the test quite closely. If the grain is small and the fracture of rather a dull color, the heat is said to have melted "hard." If the grains are large and bright the heat has melted "soft." Other indications confirm this in the way the first test piece may break under the blows of a sledge. The "hard" or high carbon steel snapping easily, while the "soft" or low carbon steel bends or flattens before fracture.

To confirm the melter's judgment, as a rule, the first test piece is sent to the laboratory for a quick test on carbon and phosphorus. When the test piece indicates a high carbon, the melter does not wait for the analysis, which only occupies about ten minutes, but may throw into the bath a few shovels of iron ore to assist in the lowering of the carbon, and, at the same time, thin the slag. In a few moments the chemist reports carbon usually 0.50 to 0.70 with only a trace of phosphorus. The melter is now satisfied that his conditions are normal. Should the phosphorus have shown incomplete removal in the first test, a second one would be taken after an interval of about fifteen minutes and submitted to another chemical analysis. The addition of the iron ore immediately after the first test would have increased the slag's basicity and fluidity and no doubt would have eliminated what phosphorus might have remained in the bath at the time of the first sample. Usually the second test shows phosphorus out of harm's way.

Should the phosphorus resist removal, that would necessitate an addition of lime to the slag which would have a tendency to cool the bath and also raise the lime content of the slag and of course intensify the de-phosphorizing action. If the temperature of the bath at melting be very high, there may be a tendency to retard the removal of phosphorus, since there seems to be certain ranges of temperature wherein de-phosphorizing does

not depend entirely upon slag conditions. It has been observed that in cases where a normal slag would refuse to completely de-phosphorize, an addition of a few hundred pounds of pig iron caused a quick and perfect absorption of that element by the slag. The action could only be explained on the basis that the pig iron so added could exert no other influence regarding the phosphorus than that of cooling the bath. This fact gives plausibility to the theory of the thermal ranges where there may be a change or reversal of affinities, or, in other words the oxidizing action is more inclined to give its attention to the carbon in preference to the phosphorus.

The activity in de-carbonizing is one that varies with the temperature and this fact also seems to apply with equal force inversely to phosphorus. The term "very hot" may seem indefinite in reference to the bath when melted, but in the absence of figures stating temperatures at the several stages of an open-hearth heat, the use of vague expressions concerning them cannot be avoided. It is doubtful that the slight ranges of temperature covering the periods affecting the removal of phosphorus can be observed by the eye even with experienced operators. It is certain that the ranges of temperature in question come within apparently normal conditions and are therefore narrow. But, if the said ranges were wider, they would be readily detected without the seeming need of pyrometry to fix them.

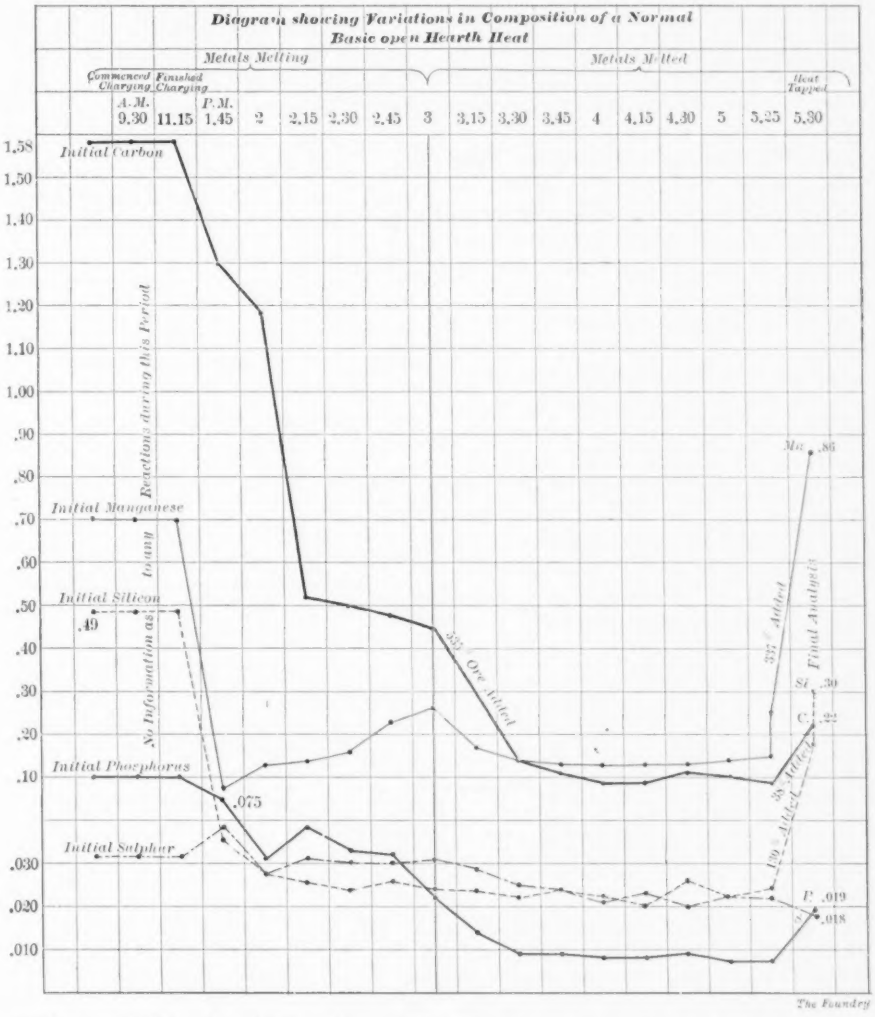
Assuming the second test sample shows a very low phosphorus, usually 0.005—0.015, further manipulation proceeds smoothly. The slag will have nearly reached its full share of lime; in other words, the lime will have come to the surface from the hearth bottom where it was charged. If the dose of iron ore has not given the desired fluidity to the slag, an addition of two or three shovels of fluor-spar will bring it about quite rapidly. Fluor-spar should be used but sparingly because excessive doses tend to aggravate the cutting action on the slag line around the hearth.

If the first or second preliminary test samples show low phosphorus the examination for that element is not carried out in subsequent tests. Only the carbon is carefully watched and after it has reached about 0.25 no further ore should be given to a bath. The carbon reduction can go on without any assistance from that source because the slag will, at that period, carry its full quota of iron oxide to actively promote decarburizing. Excessive additions of iron ore will surcharge the bath with oxide which causes blow holes and red shortness in the finished product. A liberal use of iron ore will shorten the time of making a heat and in a measure, increase the yield of metal because the reaction between the carbon of the bath and the oxide of iron furnished by the ore sets free an equivalent of metallic iron which enters the bath. But good practice demands discretion in the treatment of the bath with ore.

It generally follows that when a heat melts "hard," temperature conditions at the end of the heat will be normal because the initial amount of carbon will be high enough to produce perfect liquation and present a great enough interval of time occupied in its removal to preserve proper thermal adjustments by regular reversals of flame action, inflowing air and outgoing gases. Should a heat melt "soft," the temperature of the bath is apt to be low and without a gain in the carbon much difficulty would be encountered, with pasty steel. An attempt to raise the flame temperature to get the fluidity of the bath would be harmful to the roof and brick work of furnace through scorching. But recourse is had to extra doses of cold pig iron to furnish the necessary carbon and thus promote fusion and other desirable conditions. Such practice is called "doctoring" but the outcome is never so satisfactory as when the heat is worked naturally. It is a safe rule that when a heat melts "soft" and consequently dull or cold, that the first preliminary test will show thorough slag absorption of phosphorus. This fact gives plausibility to the theory

of the temperature ranges affecting the removal of that element.

When the carbon reaches a point where the test samples are very tough, difficult to break and showing, upon fracture, a fibrous structure, and chemical tests show them to be between 0.10 to 0.14 carbon, preparations are



made to finish the heat. If a test spoon of liquid steel be taken from the bath and poured over the lip, running freely and leaving the spoon clean and free from skull or chilled steel, the temperature of the bath is considered good. The next step will be to quiet the bath by adding one-third of a weighed portion of ferro-managanese. This material as shown in previous sections takes precedence over the remaining carbon in de-oxidizing and so lessens the ebullition of gaseous carbon. After an interval of a few minutes the heat of metal is tapped into a pre-heated ladle and before the slag comes the final doses of ferro-manganese and ferro-silicon are then thrown in with the stream of steel and the heat is said to be finished. The furnace bottom is now drained of slag and some remaining pools of steel. The slag line is patched with raw dolomite and whatever holes there may be in the bottom are filled with ground magnesite. The furnace is then ready for a succeeding charge.

Details of Re-carburizing.

It will be noted that in basic melting no ferro-silicon is added to the bath to deoxidize as in acid practice. To do so would be to invite irregularities such as a release of phosphorus from the slag, a re-absorption of it in the bath, a cutting of the hearth, a great loss in available silicon and uncertainty as to quality of product. The measure of the power of the slag to take up phosphorus from the bath is its basicity and any addition of silicon decreases that property. The better practice is to make the silicon additions entirely in the ladle. If the ordinary grade of ferro-silicon (nine per cent—13 per cent Si) is used, it must be melted before it can be added to the ladle.

The melting may be done in a small cupola, or a reverbatory furnace fired with coal, or in a suitable oil furnace. In any case, there are certain annoyances, such as hitches in getting the ferro-silicon melted at the proper interval and in condition to transfer the desired quantity to the steel ladle when the heat has been tapped from the open-hearth furnace. There are also losses in available silicon due to oxidization when melting the charge of ferro-silicon by any method. These losses are variable and cannot be avoided. In making calculations allowances must be made for such losses. It would not be practical to add the dose of ferro-silicon, using the common grade, cold. The drawbacks just mentioned can be avoided by the higher grade electrolytic ferro-silicon which usually carries about 50 per cent silicon. The quantity of this latter grade for a dose is only about one-fifth of the commoner kind, so that there is no need to melt it before using thus eliminating the difficulties arising in handling the ordinary grade. The heat units evolved in the reaction between the oxide of iron contained in the molten steel and the silicon available in the high grade ferro-silicon, more than offset any chilling effect set up by the addition of a cold charge of that material. There is always some consumption of silicon in de-oxidizing and it is greater in basic melting than in acid. The loss varies between 20 per cent to 30 per cent of the total available, particularly in using the common grade of ferro-silicon.

The greater part of the ferro-manganese addition can be made in the ladle with but a slight loss in de-oxidizing and with no chilling effect upon the liquid steel.

If the finished product is to show a final analysis as follows:

C ..... 0.20 to 0.25 per cent.
Si ..... 0.30 to 0.35 per cent.
Mn ..... 0.65 to 0.85 per cent.

the calculations for the recarburizers, will be, as an illustration, made on the basis of molten Fe Si with nine per cent to 13 per cent Si and also on Fe Si carrying 50 per cent Si, the weight of the charge being 36,000 pounds. Taking the lower limit of silicon in final analysis there will be required

$$36{,}000 \times 0.003 = 108 \text{ pounds Si.}$$

With the ferro-silicon averaging 11 per cent silicon the charge of that material to furnish 108 pounds silicon is

$$\frac{108 \times 100}{11} = 928 \text{ pounds,}$$

but there may be a combined loss of the synthetical silicon in melting and in de-oxidizing of about 20 per cent; it will be necessary to increase the charge of ferro-silicon accordingly to $982 \times 1.2 = 1{,}178\frac{1}{2}$ pounds. The carbon carried in by that quantity will be

$1{,}178\frac{1}{2} \times 0.015 = 17.67$ or 18 pounds

divided by the weight of the charge

$$\frac{18}{36{,}000} \times 100 = 0.04 \text{ per cent available carbon.}$$

To get the manganese in final analysis to equal say 0.75 per cent it will be necessary to add:

$36{,}000 \times 0.0075 = 270$ pounds manganese.

Standard ferro-manganese carries 80 per cent, then to have the synthetical manganese it will require

$$\frac{270 \times 100}{80} = 337\frac{1}{2} \text{ pounds Fe-Mn.}$$

The residual manganese in the bath at the time of additions will be an in-

crement and it will nearly equal the loss mentioned in available manganese. From the ferro-manganese there will be carbon furnished to the extent of

$$337\tfrac{1}{2} \times 0.06 = 20\tfrac{1}{4} \text{ pounds.}$$

$$\frac{21}{36{,}000} \times 100 = 0.05 \text{ per cent C.}$$

The addition of ferro-manganese is divided into two portions, 1-3 in furnace and 2-3 in the ladle.

Summarizing the recarburizers there will be available in total elements.

	Residual.	Fe-Si.	Fe-Mn.	Total available.
C	0.12 +	0.04	0.05	0.21 +
Mn	0.15 +	—	0.75	0.90 >
Si	0.02 +	0.36	—	0.38 >

The foregoing available composition in regard to the carbon will be very close to the required analysis and the complete analysis compared with the total available elements will depend in a great measure upon the condition of the bath in regard to the quantity of oxide formed during the conversion and refining of the charge.

If the electrolytic ferro-silicon be preferred to the common grade, it will not change the details in regard to the dose of ferro-manganese which will remain the same as shown in preceding paragraphs. The figures for silicon can be taken as follows:

$$36{,}000 \times 0.003 = 108 \text{ pounds Si.}$$

$$\frac{108 \times 100}{50} = 216 \text{ pounds Fe-Si.}$$

Since the electrolytic silicon being in a condensed form the de-oxidizing effect is more pronounced and efficient. The losses are much less than in the ordinary grade. There arises no particular need to take into account the losses or differences between the synthetical analysis and the final. It is not necessary in adding silicon as a deoxidizer to work extremely close to figures for finished analysis, if enough is added in the first place to accomplish the purpose. The amount of carbon furnished by the electrolytic silicon is quite small $216 \times 0.0025 = 0.054$ pounds and $\frac{0.54}{36{,}000} \times 100 = 0.001$ per cent or practically nothing at all. From the ferro-manganese there will be 0.05 per cent which added to the residual, assumed to be 0.12 per cent, would make the available carbon 0.17 per cent, a figure rather low for ordinary castings where the tensile strength required may be 60,000 to 70,000 pounds per square inch.

Two methods may be followed to raise the carbon to 0.20—0.25 per cent. One is to finish the heat at a correspondingly higher residual carbon. The other is to make up the difference between 0.17 and 0.20—0.25 by an addition of solid carbon in the form of coke or anthracite at the time of dosing in the ladle.

Concerning sulphur there is no great effect upon it at the time of recarburizing. The figures for the residual and the final analysis are practically the same excepting occasionally a small decrease coming within the common errors of chemical tests. If any differences occur outside of them, the lessening of the sulphur can be assigned to the influence of manganese in combining with some sulphur and passing off into the slag as a manganese sulphide. No gain in sulphur at this stage has been observed in the writer's experience.

If the initial phosphorus is kept low in the charge about, 0.10 to 0.15 per cent and with only 0.005—0.015 per cent remaining at the time of finishing the heat, the synthetic silicon in the action of de-oxidizing in the ladle changing to silica passes into the super-natent slag, combines with the lime, liberates or releases some phosphorus held there, which immediately reverts to the molten metal and raises the analysis of that element. Under such conditions, taking a sample when about one-half of the metal from the ladle has been poured, there will be found a marked increase of the phosphorus over the residual so that the finished steel will show 0.02—0.03 P. The re-phosphorizing in the ladle goes on continually so long as the metal remains liquid and if a sample were taken from the last portion of metal in contact with the slag, there would be found a still further gain in phosphorus. If a much higher initial phos-

phorus were charged there would be a still greater reversion, and castings poured at the end of a heat might be found with a content of phosphorus near the point of being objectionable. This feature of re-absorption is peculiar to the basic process and is more noticeable in the steel castings practice than in the production of ingots for rolling purposes, because in the latter product the silicon added at the end of a heat is much less than in the former. Hence the importance of not charging large quantities of highly phosphoritic stock in the manufacture of basic steel castings.

The melting losses depend upon the character of the stock and the conditions of practice and may vary from six per cent to 12 per cent of metal charged. In representative plants with establish and extensive experience a yield of 93 per cent in the ladle can be considered a fair average.

CORE SANDS AND CORE BINDERS.*

BY E. D. FROHMAN.

The question of sands resolves itself into a point that there are three distinct kinds of sand. First—you have a crushed silica rock which shows under the microscope or under an enlarging lens that each particle of sand is rough and jagged edged. Then we have the beach or lake sands, where each pebble shows itself as rounded, caused by the washing of the waves and the sands rolling on one another for centuries. Then we have the bank sands which are mixtures of both the jagged edges and round corners and loam or clay.

Every sand found in nature is made up of these three component parts, jagged, rough, sharp corners—part rounded particles and loam or clay.

The question of sands is the most important in speaking of core binders as we show later in this article. We give here a series of sands showing the amount of clay therein contained, and the tensile strength shown to break these cores.

*Read before the Cleveland Foundry Foremen.

The question of core binders or core compounds, is today spoken of as one of the most important factors. In former times horse dung and stale beer were used in varying proportions in the foundry, the amounts, depending upon the sands used.

In the early days of foundry practice, the idea of using burnt or gangway sand was unheard of. Finally, rosin which was cheap and a by-product in the manufacture of turpentine came to be generally used and as it made a good and a cheap core and a core that readily cleaned from the castings, has been used up to the present time in varying amounts, but its use is now on the wane, owing to the rapid rise in price and the fact that rosin can be used in various other manufactures.

Then linseed oil came into use, the cheaper grades being used, and also being a by-product in the manufacture of oil. Linseed meal is also a by-product which was used in the foundry for making cores. The price of this has steadily gone up in the last decade and the foundrymen were again compelled to look about for a new core binder or core compound.

Then we came to know of flour sweepings which were secured from the various mills in each individual neighborhood. Flour is used on account of its cheapness, not on account of its advantages, for a core made with flour will swell and for that reason flour is not an ideal core compound. As flour advanced, owing to the price of wheat advancing, flour was adulterated only to be sold cheap to the foundrymen, and the foundrymen are again on the lookout for new core binder or core compound. Therefore, these various causes for advancement have made the foundrymen endeavor to find and to investigate with scrutiny, what could be used to cut down the ever increasing cost in the core room.

Linseed oil on account of fluctuating has been adulterated from time to time by various people in order to cheapen the cost and keep the price

uniform. Then again, the various supply houses have put out proprietary core compounds to meet the demand but all these have been a make shift.

Then again some of the inventive geniuses in the supply business have started and put upon the market a tar compound, mixed with coal, coke and other carbon compounds to bind the sand. All these make cores but only in a way, and are again make-shifts.

Now you immediately imagine that the speaker is going to speak about his own material which is a by product from paper mills,—Gluetrin. No, I am not. This is simply a question of core sands and core binders and my idea in speaking on this subject is more to have each and every one of you give your opinion and reasons for the use of the individual materials which you may use. While the speaker naturally believes that Gluetrin is the best and cheapest, he will endeavor to show you that the binder is good and where it is good. The material for certain classes of work can not be used, especially is this true in radiator work and for vented cores made upon machines.

Flour—for certain work, where the swelling does not enter into the material, gives good results.

Now to the most important part of this paper.

We have found in our various experiments on core binders, that the amount of loam in the sand determines what class of core compound or core binder must be used. We have analyzed nineteen different grades and kinds of sand to determine with binder, whether Gluetrin, oil or flour gives the best results and in every case we have found it depends upon the amount of clay or loam in the sands, immediately comes to your minds the fact that the clay varies in the various sections. This is true, but on this pointed question we have used pure silica sand and pure kaolin added in various proportions and upon this based our calculations.

The ideal core sand is a mixture of pure silica rock powdered and about 15 per cent of kaolin. (Kaolin is refractory clay used in the manufacture of pottery and analysis shows about 80 per cent silica and the balance potassium and aluminum). While pure kaolin is expensive, in our experiments, Pennsylvania kaolin was used and is known to the trade as Welsh Mountain clay, being sold very cheap. Bank sands of various qualities seem to give excellent results whether used with flour, molasses, rosin or any other compound. We therefore, find again that this immediately shows that the core sand depends upon the amount of clay. In our experiments we have come to look upon loam as clay while to your minds loam is a mixture of sand and clay.

In our table of experiments tests of lake sands were used as a basis to contain no loam or clay and we find that in these experiments pure flour, rosin or linseed oil in their purest forms seem to give the best of results, therefore, if a second of thought is given to the matter same can be easily and readily understood. The

CLAY TESTS.

Sharp Sands.	Clay in, per cent.	Color and relative strength of sands.	Tensile strength of core in lbs. per sq. in.	Per cent of grains that passed a 100 sieve.
Chicago Lake	0.13	Dark Gray 3	0.56	——
Erie Lake	0.41	Dark Gray 4	0.47	——
Pittsburg River	1.33	Dark Gray ¾	1.12	1.7
Yellow Silica	3.84	Yellow 2	6.47	21.3
Dunbar	5.21	Yellow 2	6.18	13.3
Ithaca Glass	8.65	Gray 3	2.19	17.4
Lumberton	15.19	Yellow 1	0.71	22.8
Pittsburg Bank	16.82	Yellow Brown 2	0.75	2.7
Millville Gravel	10.01	Yellow Brown 2	1.09	1.5
Allegheny Loam	18.12	Yellow Brown 2	1.83	3.5
Burlington Island	33.33	Yellow Pink 3	2.—	45—
Fine Loamy Sands—Albany	14.19	Yellow 2	1.46	83.2
—Fine Molding for Pgh	65.02	Brown 3	1.95	82 3
Clay-Sand—Providence Fine Core	71.80	Light Gray 4	0.90	89.—

rolling of the sands has made each pebble or grain, if you please, quite round and this must have an entire coating of such material as will stick or stay there. Gluetrin compounds will not adhere in all parts of lake sand, seem to evaporate and therefore, are not best adapted for all kinds of core work, especially, is this true in small work.

The question of buckling is one of great interest, its causes are manifold and again as in all cases is question of sands. If the sand used is close and the moisture or gases of the core can not escape, a buckle will result. If the gases are there in too great a volume and they escape readily with a jump, or escape in spots or in torrents in unexpected volumes and the venting of the mold is not prepared for it, we have blowing. One great danger in the making of cores, where loam sands are used, is the cracking of castings. This shows, as you all readily know, that the core is too hard and the heat of the iron expanding the sand, causes the iron to crack.

The cracking of the iron under the core where loam sand is used can be overcome in many ways; probably one of the cheapest and best ways is to use some sawdust. Many object to the use of sawdust, claiming that the smoke hurts the eyes, and is apt to cause blowing. We have never had very serious objection to this. If this is objectionable, sea coal in proportions of about one to 25 can be used and this often opens up the sand of the core and allows same to come out readily. In this connection one of the prettiest cores that the writer has ever seen, was made from a mixture of lake sand, fish oil and rosin oil and just a small proportion of saw dust was used in this mixture and when the iron was poured the casting upturned and the sand ran from the casting. This without exception or doubt was an ideal way of cleaning the casting, but the high cost of the oil and sand made it objectionable.

In the use of our material, so called Gluetrin, cleaning out has been a serious question but one which we overcame. The same difficulty exists with many of the tar compounds upon the market today. We have found that the addition of sea coal and sawdust in large work or lump coke in the sand, overcomes this difficulty, but the point is, will or does it pay the foundrymen to go to this expense? To experiment as you may put it for us at your expense. This you must determine. For small work we have found that Gluetrin can be used with the greatest success in ordinary or lake sands with the addition of either clay water or flour and in the same proportions that the Gluetrin is used. For instance, if you use lake sands and you propose to use Gluetrin at 60 to 1, our idea is to add clay water at the proportion of 60 to 1; the flour at the proportion of 60 to 1. This will give a core that will absorb a very small amount of moisture and in every way give a core that can be used and one to be proud of. In all bank sands Gluetrin is a great money saver.

The speaker trusts that this paper will be of interest and that the discussion will be one of advantage to us all.

Remarks.

Flour.—Cannot see any difference between rye and wheat—can be dried at almost any temperature above 150 degrees Fahr.—but unless it has really been baked, so that it gives off the bread smell—it will blow badly. You can not get the bread smell at less than 350 degrees Fahr., therefore, should say that flour cores baked so as to give the least blowing, should be run at a temperature between 350 Fahr. and 450 degrees Fahr.

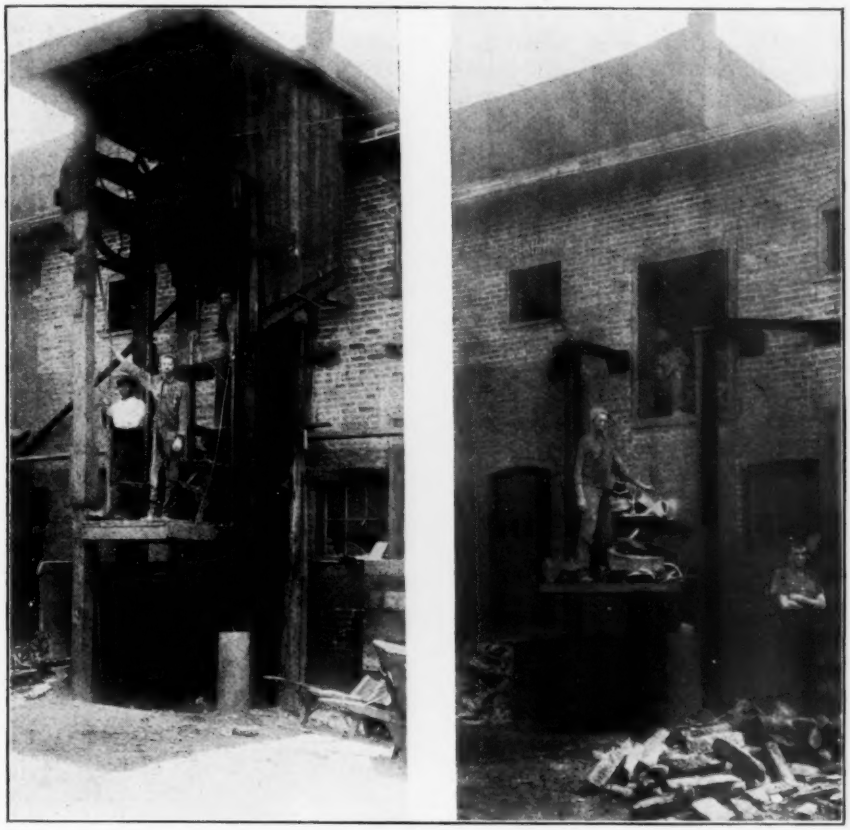
Oil.—Am not so sure about flour tests that were made at 400 to 500 degrees Fahr. and inclined to think they should get the best results approach the high limit.

Gluetrin.—Can be air dried if desired—in so far as the temperature is concerned it is a mattter of time except that you must not go over 500° Fahr. Above that, if exposed to an oxidizing atmosphere, it burns and loses strength. We bake our best cores (½ to 1½ inch round) 30 min-

utes, at a temperature of 275 to 350 degrees Fahr.; they are just as strong if baked 40 minutes at 250 degrees Fahr. You understand that time and temperature on Gluetrin cores is interchangeable and this is not true of any other binder.

THE OLD WAY AND THE NEW.

The two accompanying illustrations show views taken at a southern foundry a few months apart. For a good many years all of the iron melted, which in this plant amounted to a good many tons, was hoisted by the hand elevator shown. Under the old arrangement the load consisted of over 500 to 700 pounds, and it required at least five minutes to reach the charging platform. It was also very difficult indeed to hold men to their work in bad weather, and frequently work in the foundry was delayed on account of the fact that there was no one to put the iron on to the charging platform. The spirit of progress finally reached the works, and the new hydraulic elevator shown in the second illustration was installed. With this device it was possible to lift the load in thirty seconds, and the load was more than twice that formerly, taken up by the hand elevator. The hydraulic elevator has a 6½-inch plunger, and uses water at 300 pounds per square inch.



THE OLD AND THE NEW.

You can not judge a man by what he says any more than you can a wagon by the paint that is on it. But put him to work, and you will soon see the kind of stuff he is made of.—*The Obermayer Bulletin.*

BRASS FOUNDING

THIS DEPARTMENT IS DEVOTED TO THE TREATMENT OF ALL ALLOYS INCLUDING THEIR FOUNDING, GRINDING, POLISHING, ELECTROPLATING ETC.

"BABBITT." THE MAN AND THE METAL.

BY JOHN F. BUCHANAN.

I have been asked to give such information as I can on babbitt metal, by a firm who "Would like to make babbitt *from No. 4 up to about an 18 cent goods.*" An 18 cent goods is good—most excellent good. It is evidently more costly than *No. 4,* but what relation these terms bear to babbitt only an Alabama coon or a clairvoyant can reveal. I can just remember one occasion on which I handled *No. 4,* and it was an excellent antifriction metal listed by a London firm as *"Navy Bronze (No. 4.)"* The composition, I afterwards learned, went on all-fours thus: Copper, 4; antimony, 16 (= 4 fours); Tin 36 (= 9 fours); Lead 44 (= 11 fours); total 100 = 25 fours. Well, the fours in this composition are its only misfortune. For light or medium load high speed machinery it would be hard to find a better metal and I would advise our friends in Alabama to adopt it for their pulleys, saws, etc., and make it their own. All the same the compound is about four removes from the genuine babbitt, and that leads me to remark that we confuse and abuse terms, especially metallurgic terms, so freely that even a simple enquiry like that in the first sentence misses the point. However, I am down to say something about *the man* and *the metal,* and I will.

Babbitt, Isaac, American inventor, born Taunton, Mass., 26 July, 1799; died 26 May, 1862. Served an apprenticeship to the goldsmiths' trade and early became interested in the production of alloys. In 1824 he manufactured the first britannia ware in the United States. In 1839 he discovered the well known antifriction metal, for which the Massachusetts Charitable Mechanics Association awarded him a gold medal and congress subsequently voted him a pension of $20,000.

The insertion of this excerpt from the *Encyclopaedia Americana* may serve to describe the man who introduced that most popular alloy of the 19th century—babbitt metal. Many people have hazy notions of Babbitt, babbitt metal and babbitting.

Babbitting, or the lining or interspacing of bearings with anti-attrition metal has done more to increase the speed and economy of modern machinery than any other single process or practice in engineering. Babbitt is a name to conjure with in engineering circles and the drummers and the ad. writers know it. But if Babbitt came to Buffalo or any other business center, I guess he would repudiate many of the metallic miscellanies hawked and passed on the unsuspecting as babbitt metal.

Remember, Babbitt manufactured britannia ware and britannia metal is an alloy of tin hardened by antimony and copper. Babbitt's metal, therefore, was purely and *simply a britannia metal,* and when he had finished with the making of it, it consisted of tin 88.9 per cent, antimony 7.4 per cent and copper 3.7 per cent. The figures give us no information about the method of combining the metals and that is the most important thing in the production of alloys intended to undergo mechanical treatment. The improvements in the modern bronzes are as much due to correct methods of combining the metals as to the introduction of new elements. It is recognized nowadays, that the mere melting and mixing of metals together, regardless of their chemical qualities, does not conduce to the highest excellence in the combination. The direct melting of the metals to produce an alloy of more than two metals is a crude process, wrong in principle and generally unsatisfactory in the final

result. The uses of "hardening," remelting, "temper" and fluxes must be understood in order to get the best results from babbitt metal. Even the order in which the metals are melted and blended is of some importance. The proper course is always to make a "hardening" for alloys of metals showing disparity in fusibility and specific gravity. Babbitt's "hardening" was made by melting copper 4, then adding gradually tin 12, antimony 8, and finally a further addition of tin 12. To make the "lining" metal 72 parts of tin was melted and the 36 parts of "hardening" dissolved therein, so that the alloy was made at a low temperature —practically at the heat of melted tin. Overheating is a fruitful cause of dissatisfaction with the wearing and working qualities of anti-friction metals. The effect of high temperatures on metals of low fusibility is always harmful, more especially if the metals have a tendency to crystallize. In cooling, the refractory combinations (copper, antimony, tin) set first, leaving the more fusible combinations (tin, antimony, copper) to solidify on the surface. That is why in the directions for using genuine babbitt metal we are told to cast the working face of the bearing downwards if possible, and to avoid high temperatures and slow cooling. The latter conditions produce bigger crystals and a greater separation of the constituents in the alloy weakening its cohesive force and increasing the coefficient of friction.

The properties which make babbitt metal so valuable are its power of accommodating itself to a hard unyielding surface, its capacity for taking a polish, its power of resisting certain chemical influences, and its low melting point. Genuine babbitt metal will not cut, scratch or heat the journal and after being in use for some time the bearing takes a glittering appearance on the surface. But all that glitters is not babbitt! The variations in the genuine babbitt metal are limited, but the commercial grades sold for babbitt metal are endless and the prices sometimes prove that tin is barred as a luxury.

During the years of my apprenticeship Babbitt's patent metal was the only thing available for lining bearings, etc., but in twenty years many changes are possible. It was found that babbitt alloy was greatly improved as a self-lubricating metal for fast running light machines, when a portion of the tin was replaced by lead. Further experience brought out the truth that properly hardened lead was equal to hardened tin as a metal for anti-friction purposes. 'Twas then the flood arrived!

For some years it rained anti-friction metals. They were registered under all sorts of fancy titles. Beginning at zero, they worked right through the glacier-

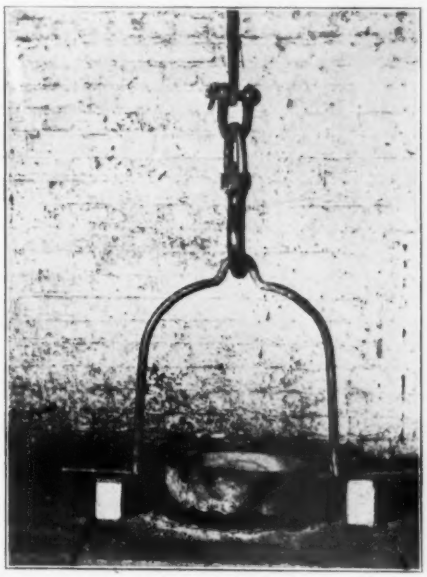


FIG. I.—POT IN FURNACE.

cum-glyco period into the heart of Greek mythology. By comparisons the staying power of Atlas, the strength of Hercules and the defiance of Aja were set at nought. The Bull and the Bear were driven tandem on the market, while the Stone and Rock Bronzes understudied the Parsons. At the sign of the White Ant the Navy casts Anchor and upholds the Crown what time Vulcan pursues a Palmer with a Kingston brogue and a Magnolia bloom in his buttonhole. Faugh! There are too many of them; we shall soon want a standardizing bureau for the anti-friction alloys,—registered and unregistered; equal to babbitt, better than babbitt and —

babbitt. If one of this bab-bilious crowd comes along pestering you to buy antimonial lead or columnious babbitt for "an 18 cent goods," instead of answering, "Nope; not today," recite the following:

*"Bee-Baw-Babbity, Babbity, Babbity.
"Bee-Baw-Babbity, Babbity Bowster Barley."

If that drummer does not get up and kiss you, he's no Scotchman, and he'll

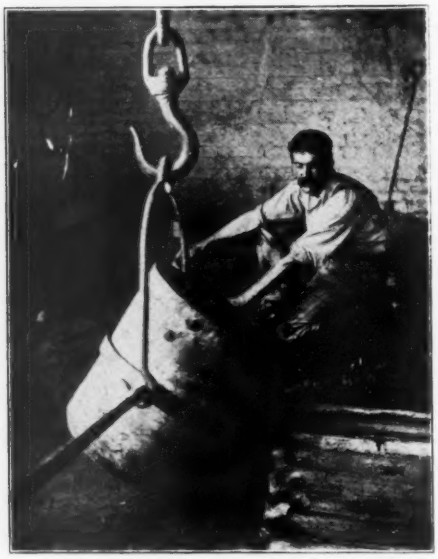


FIG. 2.—POURING METAL.

be glad to escape with his life and samples before you proceed with the rest of the incantation.

Now, if you should happen to want the best babbitt or anti-friction metal that can be made, make it yourself thus: Select the purest metals that can be had and the most suitable recipe for the duty of the alloy; make a preliminary mix of the refractories in a plumbago crucible and pour it out for "hardening." Melt the metal which forms the basis of the alloy, (it may be tin, lead, or zinc,) and dissolve the hardening therein, at a gentle heat, using sawdust, tallow, or powdered sal-ammoniac for a flux. For making a large quantity in the ordinary brass furnace make a cast-iron crucible two inches smaller than the diameter of furnace; lower it into the furnace and lute round as in Fig. 1. Fig. 2 shows how conveniently such a pot may be handled; (the capacity of this one is 500 lbs.) and a more uniform grain may be had from a good sized melt than is possible with a small lot. One word of caution is needed here. Zinc should not be melted in an iron pot, but if melted in a plumbago crucible it may be poured and mixed with the other components of the alloy already melted in the pot.

The utility of babbitt metal is not to be gauged by the number of cents it costs per pound. A cheap babbitt, (lead or zinc base) well made, may give better service than a costly mixture which has been carelessly blended. Besides, the commercial grading of metals by number or title is like the private marks of retail merchants, unintelligible to the outsider. Generally the grades are for 1, light loads and high speeds, and 2, medium loads and moderate speeds, 3, heavy loads and slow or moderate speeds, and 4, heavy loads and high speeds. Such grading is reasonable for the hardness of the alloys increases with the numbers, and price does not count. The time for selling alloys by analysis is not yet, but "Come it will for a' that."

To sum up, babbitt metal is essentially a tin alloy, but modern engineering practice and commercial usage favors the continuance of the name to all metals capable of the same duty as babbitt. Hence we get three series of babbitt or anti-friction metals: 1st, the tin series; 2nd, the lead series; 3rd, the zinc series. Tin is the most polishable of the soft metals, and it alloys readily with any of the useful metals employed for minimizing the friction of machinery; it has been made the basis of the best anti-friction alloys. Lead is undoubtedly the best anti-friction medium among metals, but it wants a great deal of stiffness to stand up to the work. Copper is the ideal bond for zinc alloys, and zinc is the most expansible and durable of metals. Zinc babbitts cast well, wear well and fit snugly to the bearing.

Owing to its highly crystalline structure, antimony, the principal hardening element, should not exceed 20 per cent,

*A children's game, "kiss in the ring," Scotch style.
"Babbity"—the diminutive of Bob—to curtsy.

as it is apt to separate and rub out of the alloy,—17 per cent has been fixed as the limit by an eminent authority.

The mutual relations of the metals determine the mechanical properties of the alloys. Zinc and antimony are too much alike to be used simultaneously and tin alloys, without copper, are apt to spread under heavy loads. Due to its poor affinity for lead and tin and its low atomic volume, aluminum is not a suitable metal for anti-friction alloys. Bismuth, on the contrary, is a decided advantage up to about 1.5 per cent. This metal has been freely used in the production of some modern alloys, notably those with low fusibility, low contraction and high atomic volume. In table I are given some special mixtures which have given complete satisfaction for the duty stated.

Lastly, we have the mixtures of a manufacturer representing four grades as given in table II.

TABLE I.

For Lining	Tin	Lead	Zinc	Antimony	Copper	Bismuth
Dynamos: high speed	88	—	—	8	3.5	0.5
Marine engines	77	17	—	3	3	—
Eccentrics	5	78	—	15	2	0.25
Submerged bearings	40	48	—	10	2	—
Main bearings	34	44	—	16	6	—
Slides, Thrusts	65	—	30	2.5	2.5	—
Ry. trucks	42	—	56	—	2	—
Axle boxes (by analysis)	74 22	13.50	1 80	6.55	3.60	—
Anti-acid metal (by analysis)	78.84	14.75	—	trace	3.70	—
Plastic metal	80	10	—	1	8	1
Genuine babbitt (hard)	80	—	—	10	10	—
Genuine babbitt, No. 2	83	—	—	9	8	—
Universal bearing mtl.	6	78	—	16	—	0 25
Antifriction castings	24	—	80	—	4	—

TABLE II.

Grades	1	2	3	4
Tin	77	77	17	—
Zinc	—	17	77	77
Lead	17	7	7	17
Antimony	7	—	—	6
Copper	6	6	6	7

In each case the metals represented by the figures, 7, 17 and 6 constitute the "hardening." These are what are termed copper hardened alloys,—the copper content being over five per cent. This series is worthy the attention of all who are seeking for cheap, serviceable anti-friction metals.

GETTING EXPERIENCE WITH A BRASS FURNACE.

When a person starts into some new line of business it is very often found that it is the little things which give the most trouble, and often the most expense. Even in branching out into a new line of the regular business where all of the general features are the same some troublesome little difference may crop up that may be hard to locate and connect with the trouble. It sometimes happens that at the start everything goes along smoothly for a time and it looks very easy and simple and then things go wrong, and there is trouble and worry and expense until the trouble is located. A certain amount of experience has been paid for.

It seems like a very easy thing for a firm that has run an iron foundry for years to make their own brass. Besides, the nice little profit that figured out as being in it, it was nice to think of being able to get castings when they were wanted, and as they were wanted. There was a firm that figured in much that way. I don't know that they added anything for the cost of experience in making up their estimate as to what their brass castings should cost them, but I rather think they did not. At any rate they put in a brass furnace and went to making and using castings that would have been turned back on any one making them for them.

Several molders had been tried on the brass and finally a young man who was a hustler was put on. It had always seemed as though the amount of brass work that a man put up was out of all proportion to the amount of iron that was put up for a day's work. This man went to putting through more than his predecessors. It had always seemed as though it was harder to get an accommodation from the man at the brass job than from any other part of the works, but this man was obliging. He always had time to "get this piece in, for we are in an awful sweat for it," and did it cheerfully. For awhile he had "good luck" but it was not long until his castings began to come spongy, or, as one of the machinists expressed it "they looked like cheese."

"I was afraid of some of that scrap a little," said the molder, "but I will be on the lookout for it after this." He sorted over his old brass and as the next heat came reasonably good he felt that he had found the trouble, but it soon broke out again worse than ever and sorting the brass did not seem to help it.

"This sand is not fit to use for brass anyhow. It is just common sand like they use for iron. I ought to have a regular brass sand." The foreman did not agree with him but nevertheless got a load of fine sand such as a neighboring brass foundry used. Sure enough the very next heat the castings were good, and the molder felt that he had been right in the matter. In a short time they were coming worse than ever, and it began to hurt for about this time the works got very busy and it was hard to get enough brass castings even when they were all good. The foundry foreman was a young man who had never had any experience with brass until this furnace was put in and he did not know what was causing the trouble.

The molder who was doing the work at the brass furnace had worked on brass at another foundry but had never had charge of it and there was a point or two that his experience did not cover.

One of the machinists who was told to get at the rod brasses as fast as they were cast was a friend of one of the old molders. This old man had noticed the trouble with the brass but had not offered any suggestions.

His former experiences had shown him that if one wants friends around a shop or foundry it is not best to assume to know too much. Perhaps he also knew that a man is not apt to follow advice until he is reduced to the point where he has to ask for it, and even then he does not have the gratitude that might be expected toward the one who has the superior knowledge.

"The machine shop will have to quit building engines if we do not get more good brass than we have been getting lately," remarked the machinist to the old molder, as he came out to see if there were any castings for him.

"Do you know what the trouble is with that fellow?" asked the old molder with a nod of his head toward the brass floor.

"I do not, and I guess I know as much about it as he does, or anybody else for that matter. What do you think about it?" He evidently did not expect information but was merely keeping his end of the conversation going.

"A machinist can't be expected to know anything about molding, that is to say, about the fine points, but if you will watch how he lets his pot soak after the brass is melted you will see where the trouble is. My old boss wouldn't let it set a minute after it was melted, no matter who wasn't ready."

"Do you really think that is the trouble?"

"Think it! I know it is but I don't want to get mixed up in it. I don't want to have anything to do with a brass furnace. I am too old and the weather is too hot."

The machinist was good friends with the boss molder and that was how he came to mention it to him that his opinion was that the brass was staying in the furnace too long. The boss told the man who was run-

ning the brass floor to look out and not let it soak, and of course he said that he never did let it soak but for all of that the number of castings that turned up with the little holes all through them was much less.

The molder did his own melting, and the boss molder took charge of it for a few heats. The castings from those heats were passably good, but so were lots of other heats. Finally, to make sure of the matter the boss did all of the work on the brass floor for several days and in that time not a casting came bad because the surface was defaced with little holes such as had been so abundant in the other man's castings.

When that foreman puts a new man on brass one thing that he makes sure to drive into his mind is that under no circumstances is he to allow the crucible to remain in the furnace after the brass is hot enough to pour.

"It don't matter when you get your dinner, or how bad the machine shop wants a casting or where the helper is or anything else; that brass has got to come out as soon as it is ready or there is going to be trouble, and don't you think that you won't have your share of it," was the way he was wont to explain the urgency of the case.

This is the only one of the matters that has to be learned, and the learning of which costs money, somebody's money, and it can cost a whole lot, for it is one of those little things that everyone recognizes as being right to do as soon as it is mentioned, and it is such an easy thing to not do when something else takes the attention.

OSCAR W. BURNS.

THE TUMBLING BARREL AND ITS USES.

BY HERBERT J. HAWKINS.

The tumbling barrel in its different phases is coming into more general use every day wherever large quantities of small metal goods are made, either of brass or iron. The tumblers are especially useful in handling castings, but are also of great merit in cleaning and polishing stamped goods, particularly of steel.

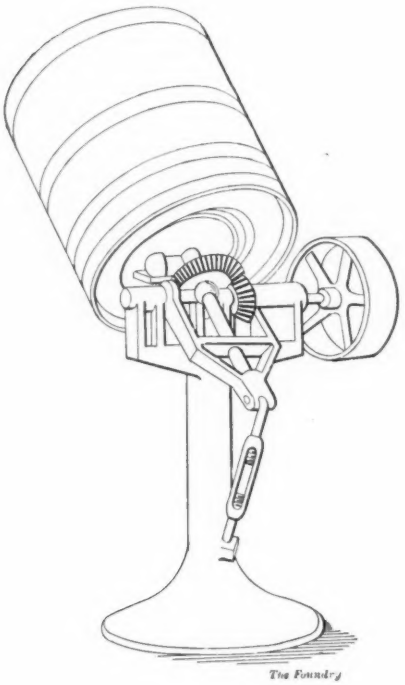
A new use for the water tumbler, which is usually octagon or square in shape is as follows:—After tumbling the work in the water to remove the sand, remove all water from tumbler and add from one-half to one pound soap powder with just enough clean water to make a thick creamy lather; close the barrel up tight and allow to tumble about two to three hours. The result will be surprising. This operation is especially useful upon malleable castings. It is quite possible to finish work in this manner which is to be brass or copper plated, so that it will require no other polishing whatever.

There is a great quantity of small cast work now being polished on the wheel, which if run in the soap powder for three hours, would have the surface uniformly polished and with a high luster; after which it is only necessary to remove from the lather, rinse and plate, as the castings will be perfectly clean and in fine shape to take the deposit. Any tumbler that will hold water is suitable for the soap powder, either the horizontal or oblique barrel, though if the latter is used the work should be run somewhat longer. The work may remain in the tumbler any length of time without drying as the soap water will prevent tarnishing or rusting.

The dry method of tumbling is in very general use wherever large quantities of small iron castings are made. Sometimes an ordinary tumbler with a tight fitting door is used. This is wrong. When the tumbler is tight or nearly so the small particles of sand and iron after being removed by the tumbling process are ground into the surface of the work, forming a black greasy metallic coating, which hinders the polishing process materially. As soon as the castings become thoroughly coated with this substance all polishing ceases. A tumbler with exhaust fan attachment is in very general use in many shops and I believe gives very general satisfaction. But they are

usually very bulky and require considerable space and at the same time are quite expensive to install.

A tumbler which will do the work equally as well and at the same time is not so heavy and bulky and may be installed at less than half the cost is made of boiler iron, about 3-16 thick, a suitable door being made in one side and fastened with hinges. Then ½-inch holes should be drilled through the barrel from six to eight inches apart in rows around the whole circumference of the barrel. This will allow the fine particles of metal to sift



The Foundry

through as they are removed from the casting, thus removing all dust and dirt as effectually as does the suction fan, leaving a clean casting and a high polish.

A frame of wood may be made in which to run the tumbler, using 2 x 4 oak pieces, ordinary shafting hangers bolted to the floor, also make good bearings in which to run the barrel. The axle of the tumbler does not run through the inside but is attached to a flange and bolted on each end. Sometimes steel ribs or slats are bolted to the inside of the tumbler, about eight to ten inches apart, to prevent the work from sliding. This is not necessary except with particular kinds of work. Castings when run in a tumbler of this kind for from three to four hours come out very clean and bright, owing to the absence of the dust which has sifted through the holes as fast as made. If only a small amount of work is in the tumbler it thrashes about and does not polish. If the tumbler is too full of work, there will not be room enough to allow the work to take the proper tumbling motion necessary to good finish and high polish. To get the best results the tumbler should be filled about half full of work.

If a smoother and brighter surface is required, leather scraps free from greasy or oily pieces may be added, using about as much leather as there is work. Sole leather scraps from a shoe factory are the most satisfactory to use. If the work is run with this leather for about two hours it will take on a very high polish and bright color. The leather may be used several times or until it becomes smooth and greasy, when it is no longer fit for use. Where several of these tumblers are in operation they make considerable noise and create a good bit of dust which is annoying and disagreeable to say the least. The noise and dust may be reduced to a minimum by covering each tumbler with a wooden shell or box which will retain the dust and deaden the noise very materially.

If all castings that are to be finished or polished in the tumbler were first put through the proper pickle for removing sand and scale, it would save considerable time in the tumbling operation.

The tumbling barrel shown in the accompanying cut is one that is simple in construction and may be used in different ways on small work. It is used for dry polishing, also for wet polishing with the soap powder, for which operation it is particularly adapted. When properly fitted up, it is used as a plating barrel for either copper or nickel. The particular advan-

tages of a machine of this kind are its several uses, the small floor space it requires, and last but not least the work is always in plain sight where its progress may be observed.

BRASS AND BRONZE FOR THE AUTOMOBILE.

BY H. B. DEPONT.

The two alloys, brass and bronze, play a strong part in the general make-up of the automobile, and for that reason it is quite necessary that good grades of the respective alloys be obtained. The bit of data set forth in this article brings out the chemical composition and true nature of some of the grades of brass and bronze being put on the market. The particular castings from which this data was derived were made especially for automobile construction, and, when it was possible to do so, tension, transverse and compression test bars were poured from the same heats in order to obtain a line on the physical properties of the castings.

It was not always convenient to run the test-bars from the same batch of metal as the castings, so other heats were utilized to fill that deficiency, and the chemical and physical properties of the bars were used for reference and filed away for use in specifications if they proved fit. It was desirable, however, that each large lot of castings be accompanied by the test-bars, but it was found that the variations in the different heats made it almost impossible and useless to try and figure on the whole lot from the three bars cast. The writer will leave the physical tests and the bars for some future article and will take up a few of the castings used.

The castings for automobile work, up to a year or so ago, were not taken into very serious consideration by the company employing the writer, and it was the scheme rather to use anything in the brass or bronze line than to figure out by chemical or physical tests, or to consider the advisability of assigning the piece to some particular work, or using something more fitting.

In fact, the field was new at that time, and is now for that matter, and, as no very extensive experiments were carried on up to say a year ago, it is no wonder the yellow alloys did not receive their due share of attention. The laboratory in which the work was carried on was equipped and conducted by the writer, and was probably the only chemical laboratory in the country, devoted to automobile work exclusively.

Brass and bronze became the hobby, and a very sensible hobby it was, for during the life of the laboratory much valuable data was acquired, which, if properly handled by the founder will produce the sought for results. Every type of casting that had a place in the rig was drilled into, the analysis made, and the results filed away, and a close watch kept on the casting, whenever and wherever it was possible. Of course, all the castings used did not have the same strain and wear, therefore many of the analyses are no more than references for various compositions. Whenever a rig was turned into the experimental department, an inspection was made and if it was found that a bronze bearing or a pinion or any other casting showed signs of undue wear, it was taken off and tested. The following example will give an idea as to the manner in which the observations were carried on:

Cu	Sn	Zn	Pb	Sb	Fe
79.62	13.66	1.08	5.30	—	0.36

This casting, a "cam-shaft bearing," was taken from a car turned in for repairs, and was found to be in exceedingly bad shape. One side of the bearing was worn nearly through, and the surface of the piece showed signs similar to those made by a reamer. The casting being very soft was readily dented by a light tap of a hammer. The analysis shows copper too low, the tin is about right and also the zinc, but the high lead is responsible for the very poor wearing qualities of the piece. A bearing made with the following proportions would be better

adapted for that particular use:

Cu	Sn	Zn	Pb	Sb	Fe
83.00	14.50	2.00	.50	—	—

A bronze of this character is hard and very suitable for wearing parts as bearings or bushings. A few more analyses of bronze bushings will give a comparative idea as to the chemical constituents.

	Cu	Sn	Zn	Pb	Sb	Fe
1.	83.62	11.90	2.55	——	0.990	0.91
2.	83.50	11.96	1.76	1.707	1.03	trace
3.	83.53	11.28	2.49	1.52	0.97	0.19
4.	80.63	12.98	4.12	2.01	——	0.30
5.	82.99	14.77	1.96	——	——	0.23
6.	85.07	13.66	1.13	0.14	——	0.07

Numbers 1, 2, 3, 4, 5 are bushings; No. 6 is an engine pinion. The copper contents are fairly uniform and with the tin contents form very favorable mixtures. The lead, antimony and iron are evidently due to scrap in the metal, but the zinc was very likely in the desired mix. The above analyses ought to show from 30,000 to 33,000 pounds ultimate strength per square inch in tension in the castings if it were possible to get them in the form of the standard test bars, and subject them to the regular physical program. Lead, antimony and iron may be discarded entirely as they do not play an important part in the make-up for this particular class of work.

In bringing to a close this article it is convenient to add a few specimens of analyses which might promote a little discussion as to which particular class they belong. These analyses are of castings designed for different work about the car, some standing strain, while others stand no strain at all.

	Cu	Sn	Zn	Pb	Sb	Fe
1.	89.8	6.57	1.43	2.137	0.012	trace
2.	80.94	3.12	2.50	2.74	0.11	0.08
3.	83.12	6.16	10.38	1.12	——	—
4.	81.94	8.8	5.00	4.22	——	—
5.	86.30	10.04	2.06	1.54	trace	0.14

No. 1, is a "reserve pinion bushing," note the high copper and low tin, as against the uniform copper and tin of the other bushings and bearings in the first part of the article, this casting is not as good as the others. No. 2, is a "piston-pin plug," has no hard part to play and analysis shows it to be about a draw, as to whether it can be classed as a brass or a bronze. Numbers 3 and 4, are brackets for radiators, No. 3, by its high zinc is entitled to be classed as a brass, but No. 4 will go in the bronze class. No. 5, has a first class mixture for a "bushing" or "pinion" but it has no other part to play, than to hold up the water tank on the rig.

Lead has no particular place in auto brass or bronze, neither has antimony, they are all right for bearing metals, brasses and the like, but for the hard use the alloys are put to in the running of a rig, a clean hard copper-tin, or copper-zinc, fills the bill, so far as observations and physical testing have shown in the work carried on by the writer and others indirectly connected with the laboratory.

MAGNESIUM IN THE BRASS FOUNDRY.

There are a number of metals which are used as deoxidizers in various metal mixtures. Sodium, potassium and magnesium have all been looked upon as metals which might be used for this purpose, and many attempts have been made to use them. In many ways magnesium possesses advantages over the others, in that the metal itself can be handled in the air without igniting. The readiness with which it is oxidized, however, indicates that it will act with great energy in manufacture, for reducing of other metals, which occur in alloys. The resulting magnesium oxide has a low specific gravity, and hence arises to the surface of the metal as a slag. The magnesium may be used pure, or as magnesium copper alloy containing 50 per cent magnesium and 50 per cent copper. If the 50 per cent magnesium copper is used, from 3½ to 4 ounces should be added to each hundred pounds of brass and bronze. The metal should be melted in the usual way, and the magnesium copper introduced by means of pinchers, or with a tool of suitable form so as to hold the mag-

nesium copper below the surface of the metal while it is melting. In some cases pinchers are made which are covered with graphite. These are better than iron, brass or nickel pinchers, as the latter are sure to be melted to a greater or less extent and thus change the grade of the alloy. When the proper amount of magnesium copper has been used the castings should have an orange color. Pure metallic magnesium has been used in the same way, but the reaction is much more violent, and the 50 per cent magnesium alloy seems to blend with the metal more readily.

BRASS FOUNDRY NOTES

BY C. VICKERS

A USE FOR OLD CRUCIBLES.

When a crucible springs a leak, or arrives at such a good old age, that it is unsafe to use it for melting any more, its days of usefulness are not necessarily at an end.

For the upper part of the pot can be utilized as a crucible ring or hopper, and the bottom makes an ingot mold or "heel," as it is often termed.

The crucible ring part of the old pot is of much greater use than the heel, as the latter is merely a makeshift for an ingot mold.

The use of crucible rings is a great economy in melting brass in crucibles and any one who gets used to them will wonder how he ever got along without them.

To make the ring, take the aforesaid old pot, and with a hatchet, chop off the bottom about four inches up the side. Of course a crucible that is split is useless for the purpose, as the ring would break in two, but the average leaky or wornout crucible will generally, with a little care, furnish a ring that will last a dozen or more heats.

The ring is used as a hopper, when a crucible is "coked up" the ring is placed on top, and scrap or other metal is charged in, until crucible and ring are filled. As the metal melts, it feeds down, and the rings must be refilled with cold metal. That is continued until the crucible is full of melted metal, when the ring is removed, the pot raised, if necessary, recoked, and the fire urged, until the metal is sufficiently hot to pour into castings. It will be found that the time of melting is materially shortened, and the consumption of fuel reduced, per pound of metal melted.

In melting small scrap copper, such as old commutator bars, and contact fingers for instance, in a No. 35 crucible, I found that the crucible held 25 pounds of cold scrap. Melting without a ring this 25 pounds had to melt and sink down, before I could charge in any more scrap, then to get in 25 pounds more it was necessary to charge twice and sometimes more than twice, as each successive charge of cold metal grew smaller in proportion, as the melted metal filled the crucible.

The advantage of using a ring is in this case quickly grasped, as it permits of an initial charge of 50 pounds of cold scrap, or just double the charge without the ring. Melting then proceeds until the charge in the ring has sunk down into the crucible, when it is again filled, and so on until sufficient metal has been put into the crucible.

Many more instances of the usefulness of these rings could be given, but it is hardly necessary as any founder can readily prove the fact for himself.

Book Review.

"Tables and Other Data for Engineers and Business Men," compiled by Chas. E. Ferris, professor of mechanical engineering in the University of Tennessee. Published by the University Press, Knoxville, Tenn. Price, fifty cents. This is a leather-bound pocket book 3 x 5½ inches, containing over 160 pages of matter comprising useful tables, statistics, and other material of general interest. The balance of the book is taken up with advertising matter and a statement concerning the university and the special courses which it has to offer.

THE PATTERN SHOP

MULTIPLE CORE MOLDING.

BY H. J. MCCASLIN.

As the name implies, this process consists in the grouping or stacking together of a number of cores containing impressions of the object to be cast and so arranged that they can all be poured from one gate. This method of core molding is especially adapted to small steel castings, for in most steel foundries the facilities for pouring light pieces are not of the best. In other words, in steel foundry practice the pouring is usually done from a large bottom pouring ladle and hence it is difficult to pour small molds. The method is also especially

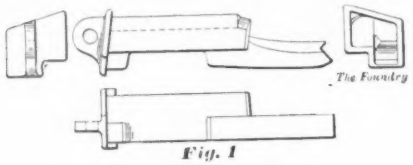


Fig. 1

applicable in cases where there is not a sufficient number of pieces required to warrant the fitting up of a molding machine.

This method of core making is remarkably well illustrated by considering the equipment necessary for making the coupling pin shown in Fig. 1. Another advantage of selecting this particular piece is that it affords an excellent example of the making of plaster patterns for the metal core boxes, these plaster patterns being made from the original wood pattern of the pin by a reversing method. A plan, elevation and cross section of the bottom plate of the metal core box used in forming one-half of the core is shown in Fig. 2, while Fig. 3 shows a plan elevation and end view of the bottom plate used in forming the remaining half. The metal plate which forms the sides and ends of the core and which is secured to the bottom plate by means of pins in the position shown in cross section on the line W in Fig. 2 and in dotted lines Fig. 3 is illustrated in two views in Fig. 4. In the illustration the frame is shown as arranged for the bottom plate illustrated in Fig. 3. The piece for forming the runner in the core is shown at X and in this case must be made of the length shown at Y, Fig. 3. The frame used upon the bottom plate shown in Fig. 2 is at the opposite hand in respect to the runner X only, as this runner has to be of a length equal to Z, Fig. 2. A pair of the half cores which have passed through the operation of ramming and drying are shown ready for pasting together in Fig. 5.

The arrangement for cores as they would appear when stacked and bolted together ready for casting is shown in Fig. 6. This simply consists of a cast iron bottom plate provided with lugs to receive holding down bolts and of sufficient length and width to receive four complete cores. The cores are stacked up to the desired height, say four feet in the case illustrated. The holding down bolts are set in position, the two top plates applied accross the cores and the whole securely bolted together. To prevent the cores from separating lengthwise, two clamps can be dropped over the top plates and wedged up as shown. The runner is next placed in position, when the mold is ready for the metal. One point that is worthy of notice in this connection is that this process works remarkably well for steel, on account of the fact that steel solidifies so quickly that it has very little tendency to work into the joints

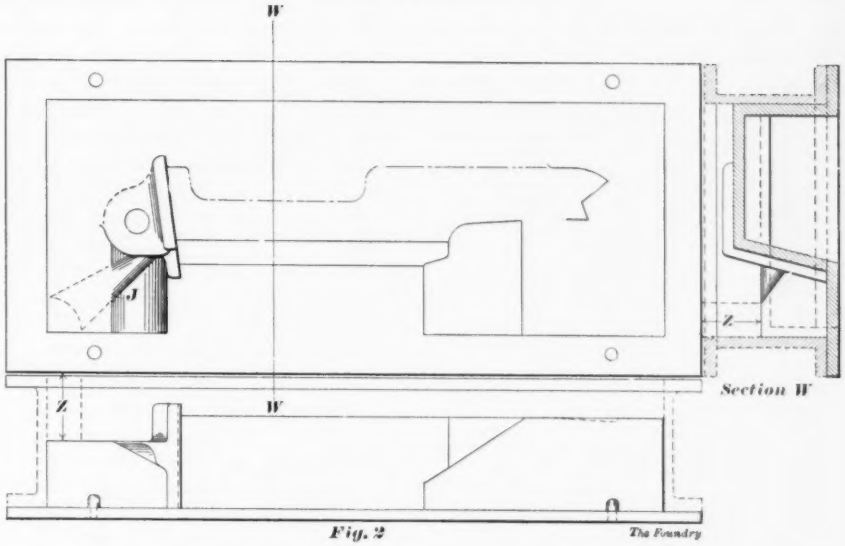


Fig. 2

between the cores and before the upper part of the mold is filled all of the runners in the lower part have chilled so that part of the mold is never subjected to the fluid pressure of a column of molten steel equal to the height of the pile of cores. If this method were used for gray iron castings it might be found necessary to place curbing about the molds and ram in sand between the curbing and the cores.

Making the Core Boxes.

As the frame which forms the sides and ends of the cores as shown in Fig. 4 is a very simple casting which is molded from a wooden pattern, its production will not be taken up in detail, but we will discuss only the method required for the production of the plaster of Paris bottom plate patterns from the original wood pattern. The wooden pattern is shown at the right of Fig. 7, while to the left is shown the board upon which the pattern is placed for making the first cast. To allow the pattern to lie flat on the board a depression A is cut out to receive the lower shoulder. The pattern is then placed in position and the material B, C and D placed about it to bring the

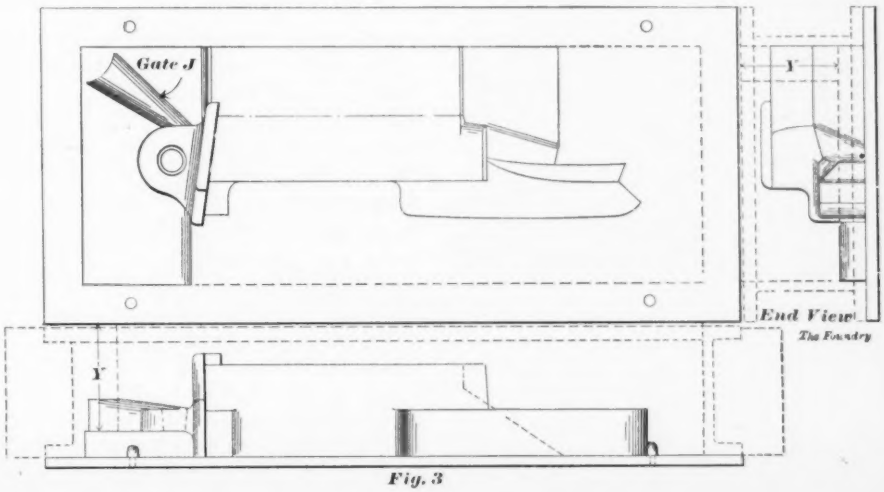


Fig. 3

parting in the right position and this is secured to the board by screws from the under side, as the pattern is also. The whole is then given a heavy coat of shellac. Fig. 8 shows

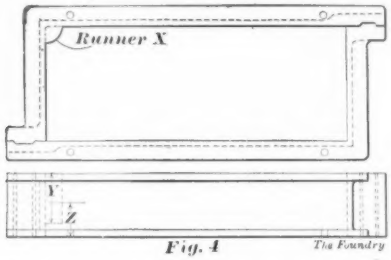


Fig. 4

the board with the pattern in place ready for making the first plaster casting. A light wooden frame or box, the inside dimensions of which correspond to the length and width of the desired core as shown in Fig. 5, and with a depth of about 3½ inches is nailed together and secured upon the board, as indicated by the dotted lines. The board and pattern are then well oiled or greased, after which attention is given to the mixing of the plaster.

To insure good results, very fine, or as it is sometimes called, dental plaster, should be used. Care should be taken to see that all lumps are broken up, and to accomplish this it is a good plan to run the plaster through an ordinary flour sieve before mixing. The plaster should always be kept enclosed and in a dry place. Two persons should work together when doing the mixing, so that it may be accom-

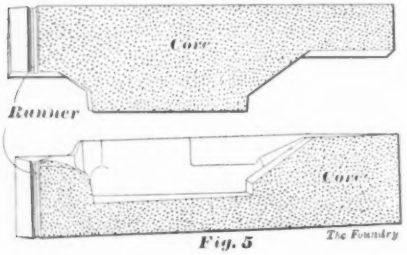
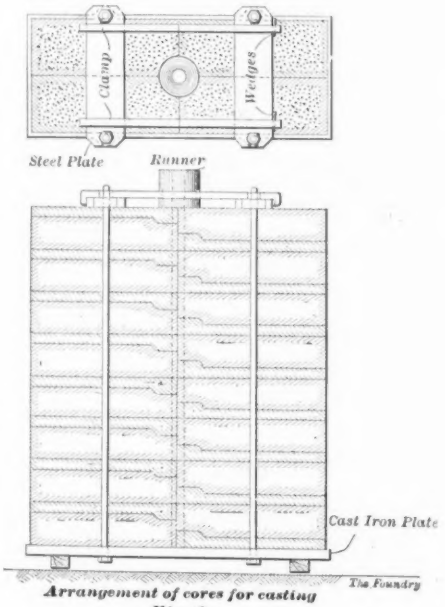


Fig. 5

plished quickly. First, fill the can in which the plaster is to be mixed with the desired amount of water and introduce a small quantity of plaster. The plaster should be introduced by one person, while the other stirs the mixture. If it thickens too fast, more water should be added. It should be mixed to the consistency of heavy cream. When pouring care should be taken to see that the work sets level and the plaster should be poured as quickly as possible over the entire surface. If the plaster has been mixed properly the screws can be taken out and the frame and bottom board removed in about 30 minutes. Should the pattern or material forming the parting stick in the least, it can generally be loosened by rapping it lightly. Blow holes are apt to appear in the plaster and when encountered they can



Arrangement of cores for casting
Fig. 6

be filled up with either plaster or wax. If this operation has been successfully accomplished the plaster cast will appear as shown in Fig. 9. Fig. 10 shows the second cast which has been obtained from the first cast shown in Fig. 9 with the aid of the wood pattern and a light frame about 4½ inches in depth. In carrying out this work the face of the first cast is shellaced and then covered with a good application of oil or grease. The pattern is then placed upon the level in the depression left vacant by it, the cast is placed upon the level board, the frame set over it, and the mixing of plaster and pouring proceeded with, as in the

former case. It is next necessary to cast the two plaster patterns, as shown in Figs. 11 and 12. The plaster pattern show in Fig. 11 is produced from the plaster cast shown in Fig. 10, while

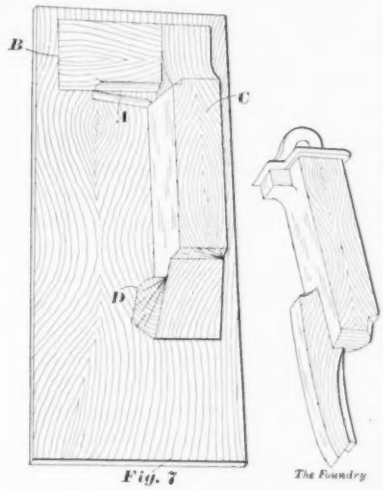


Fig. 7 The Foundry

the plaster pattern shown in Fig. 12 is produced from the plaster cast shown in Fig. 9. As the plaster casts now made are of the same length and width as the desired cores, provision must be made for the additional width or projecting edge E, Figs. 11 and 12. This projecting edge around the four sides is intended to receive the flange of the frame, as shown in Fig. 4. This is accomplished by placing the material F, which in thickness is equal to the width of the flange, on the frame shown in Fig. 4, around the four sides of the plaster cast. The entire arrangement is then surrounded with a light frame G, Figs. 13 and 14. Cross sections on the lines KK and LL of the two plaster casts shown in Figs. 9 and 10, as they would

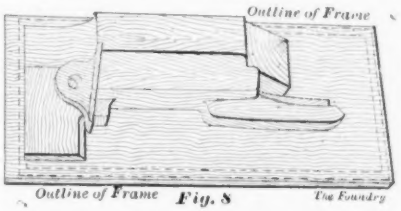


Fig. 8 The Foundry

appear arranged ready to receive the plaster, are shown in Figs. 13 and 14. As in the previous case, to prevent the plaster sticking, grease or heavy oil should be used freely over the entire surface.

At the completion of the casting of

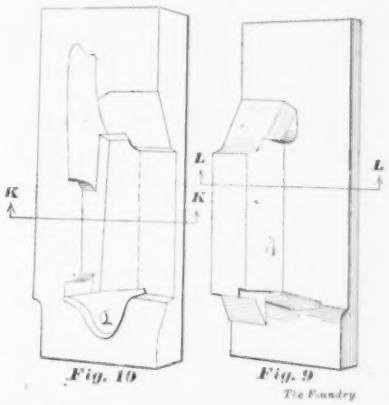


Fig. 10 Fig. 9 The Foundry

the plaster patterns, they are removed from their casts or forms and a coat of shellac applied to the face. They are then backed out to give the re-

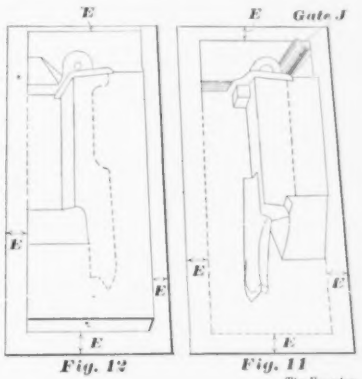
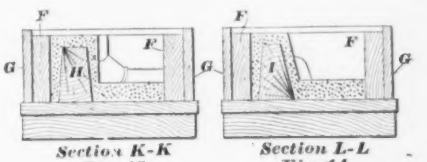


Fig. 12 Fig. 11 The Foundry

quired metal thickness. A good portion of this surplus plaster can be avoided by placing blocks H and I upon the bottom board as shown in the cross sections, Figs. 13 and 14.



Section K-K Fig. 13 Section L-L Fig. 14 The Foundry

The patterns are finished with two coats of shellac. The gate J is next worked out of a piece of wood and attached in the correct position, being

secured with shellac. The patterns are then sent to the iron foundry. When the castings come back from the foundry they are cleaned up and finished in the usual manner, the plates being doweled or pinned to the frames shown in Fig. 4.

STEPPED ON HIS CORNS.

The editor of THE FOUNDRY likes the big, good natured band saw artist who has written such acceptable articles upon this subject in the past, and only wishes that he had as magnificent a set of nerves and as steady a hand as Mr. Parry, so that he could always follow a line and split it with a band saw. The following matter was received from Mr. Parry as an exception to what Mr. Wheeler has to say about his bevel gear sawing machines.

Sawing Bevel Gear Teeth.

"The article by the editor of THE FOUNDRY, with Mr. N. A. Wheeler's letter as a base of supplies in the May issue of THE FOUNDRY under the above caption would seem to call for some comment. Quoting from the letter in which Mr. Wheeler giggles thusly,—'I do have to smile when I read about making bevel gear patterns with a band saw. This method may fill the bill, but I am not prepared to say anything about it. I never saw a pattern made this way,' leads one to believe that Mr. Wheler, who has been making patterns since the civil war, might better have devoted his energies in some other line. Again he tells us that it makes him laugh to think of any one's monkeying with a band saw when better results could be obtained in less time with a special meat saw, such as his machine suspiciously resembles.

"Without in the least wishing to jar Mr. Wheeler's feelings, perhaps it would not be amiss to wake him up to the fact that capital in the east, while always willing to back a good thing, is devilishly shy on things mechanical emanating from the golden west side of the Rockies.

"Now, with all respect to the editor of THE FOUNDRY, who seems to be taken with this device, candor compels the statement to be made that it is at least but a crude affair, theoretically correct in principle, but most decidedly incorrect in practice, for the following reasons: As the teeth of the saw must of necessity be sufficiently distant from the saw frame or holder to insure clearance for the deepest cut within the machine's limitations, it follows that lateral rigidity (absolutely essential for the work) is conspicuous by its absence unless the saw blade be of heavy gauge, in which event conformity is lost. Hence it brings us face to face with that condition best described as between the devil and the deep sea. Again, his saw is loafing half the time, while the good old band saw is always on the job.

"While Mr. Wheeler may have made a 12-inch wheel with 60 teeth in 155 minutes, I would be ashamed to look the wheel in the face after subjecting it to such unkind treatment as that contraption appears capable of applying, and I am very sure that if compelled to send such a pattern to the local foundry, I would hire the best pugilist in town to take it there, as life is distressingly short and molders are proverbially quick tempered.

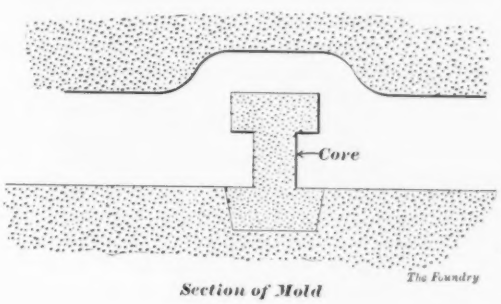
"No sir, I for one will stick to the band saw that has never turned me down on gear work, be it spur, bevel, skew or spiral, and until some genius this side of the Rocky Mountains, who is not given to smiling and laughing at the honest efforts of others, does really invent a better machine than that illustrated on page 170 of your May issue, it will be the band saw 'for mine.'"

WM. H. PARRY.

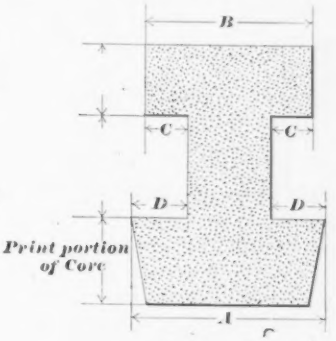
T-SLOT CORES.

Inquiry.—We should like to inquire through your columns as to the proper arrangement for fastening T-slot cores in castings, such as face plate castings, lathe carriages, etc. Our molders have been in the habit of fastening them with spikes, having the head spike hold the core down, but wherever a spike is inserted in the sand it makes a spot in the finished casting which we would like to obviate.

Answer.—In reply to the above inquiry as to fastening of T-slot cores in molds without the use of nails or chaplets, we may say that the accompanying illustration may serve to make the matter clear. This illustration shows a form of core which is used by the writer with good results. At the left of the figure is shown a section of the mold with a core in place, while at the right there is a detailed drawing of the cross section of the core. It will be noticed that the print portion of the core is wider than the T-slot,



Section of Mold



Section of Core

and hence when the core of this cross section has been set into the depression left vacant by its core print and the metal flows into the mold there will be more area exposed in the width A than in the width B and the metal which will exert a lifting force under the overhanging C will be more than balanced by the metal bearing down on the portion D. When cores are made and carefully set according to this system, no nails or chaplets will be required to hold them down.

H. J. McCaslin.

TRADE PUBLICATIONS.

The Bristol Co., of Waterbury, Conn., is sending out a 4-page folder describing and giving prices on the Bristol patent steel belt lacing.

Geo. G. Blackwell Sons & Co., Ltd., of Liverpool, England, are sending out the fourth edition of their little booklet entitled *High Grade Alloys*. This is 4 x 5¾ inches and contains over fifty pages of matter relative to special alloys, including those containing many rare elements. This catalog is of special interest to steel manufacturers.

The Ingersoll-Rand Co., of New York, has issued a catalog describing the Imperial Type X air compressors, which this company manufactures. This is standard size, 6 x 9 inches, and contains 32 pages of carefully written matter descriptive of these machines.

The Rockwell Enginering Co., of 26 Cortlandt street, New York, is sending out an 8-page standard size pamphlet, (6 x 9) describing the Rockwell pot furnaces for melting soft metals and for lead and cyanide hardening. A furnace of this type is especially useful for handling some classes of pattern metal.

The Goldschmidt Thermit Co., of New York, is issuing a little catalog 3½ x 6¼ inches entitled "Thermit—What You Can Do With It." This contains a large amount of very useful information along this line, including the various applications of thermit in foundry work.

The J. D. Smith Foundry Supply Co., of Cleveland, has had made a standard size, 6 x 9, cover, in which can be assembled groups of leaves of the same size describing the various devices and specifications manufactured by this company, which include core ovens, core oven cars, brass melting furnaces, pot lifting devices for brass furnaces, water tumbling barrels, emery grinders, etc.

The Yale & Towne Mfg. Co., of New York City, is sending out a standard size, 6 x 9 catalog descriptive of the Yale & Towne portable electric hoists, which contains 24 pages and illustrations showing many applications of these hoists to various classes of foundry work.

METALS IN FOUNDRY PRACTICE

Devoted to inquiries from Practical Foundrymen on subjects relating to the Melting and Using of Cast Iron, Malleable Iron and Steel.

The following experts answer questions in this department:

W. J. Keep, Cast Iron.

J. B. Nau, Metallurgy of Steel and Steel Castings.

Dr. Richard Moldenke, Malleable Castings.

We have also made arrangements with several others to act as special contributors. All inquiries should be addressed to the Editor of THE FOUNDRY, and they will then be forwarded to those in charge of the different subjects.

CAST IRON NOTES.

BY W. J. KEEP.

BLOW HOLES IN GEAR TEETH.

During the past month my opinion was asked regarding this matter. An overstrain had been put upon a geared drawing press and instead of the belt going off, five teeth of the large gear were carried away.

These teeth were directly over the junction of an arm and the rim. The gear was four feet six inches diameter, the teeth were six inches long and one inch wide at the base.

The cut shows a part of two of the teeth. The grain at the base of the teeth was so loose that it could be picked to pieces. One-half of the tooth that gave way first was a mass of large blow holes which had been filled with cement. The manufacturer of the machine had guaranteed against poor material and workmanship whenever found and was asked to furnish a new gear under the guarantee. This was refused because he claimed that the break was caused by the overstrain and not from the defective gear. The pinion that worked into this gear also stripped, but the teeth were sound, and no claim was made for this. When the new pinion arrived one side was full of blow holes which were full of cement, so that it was necessary to return it.

The firm that made the gear have no foundry, but purchase their castings, therefore the temptation to use defective castings does not exist.

The following quotations from the firm's correspondence are interesting:

"It is difficult for us to understand how the defects which exist in the way of blow holes in the casting would cause an accident of this kind, except in case of an overload. The fact that there were blow holes at the point that the break occurred is not evidence in this case that this is what caused the accident and we ask you to bear the cost of repairs.

"We do not agree with you that the workmanship on the gear in question was faulty.

"We fill these holes with cement—not to hide the defects from our customers, but to keep grit and dirt from working out of the blow holes, and to give the work a better finish in appearance.

"You must realize as well as we do the impossiblity of preventing blow holes in work of this character."

This was such an interesting case that I thought it suitable for "Cast Iron Notes." I do not propose at this time to suggest methods of making solid gear castings as this has been treated in almost every issue for several months.

I thought I would ask the opinion of at least one maker of machinery and the following is their reply:

William Sellers & Co., Inc.,
Philadelphia, April 21, 1906.

Mr. W. J. Keep, Supt.,
The Michigan Stove Co., Detroit, Mich.

Dear Sir:—

Your letter of 18th inst. has been handed to us by our Mr. Outerbridges, together with your letter to him of the 19th with the accompanying interesting photographs of defective gear teeth.

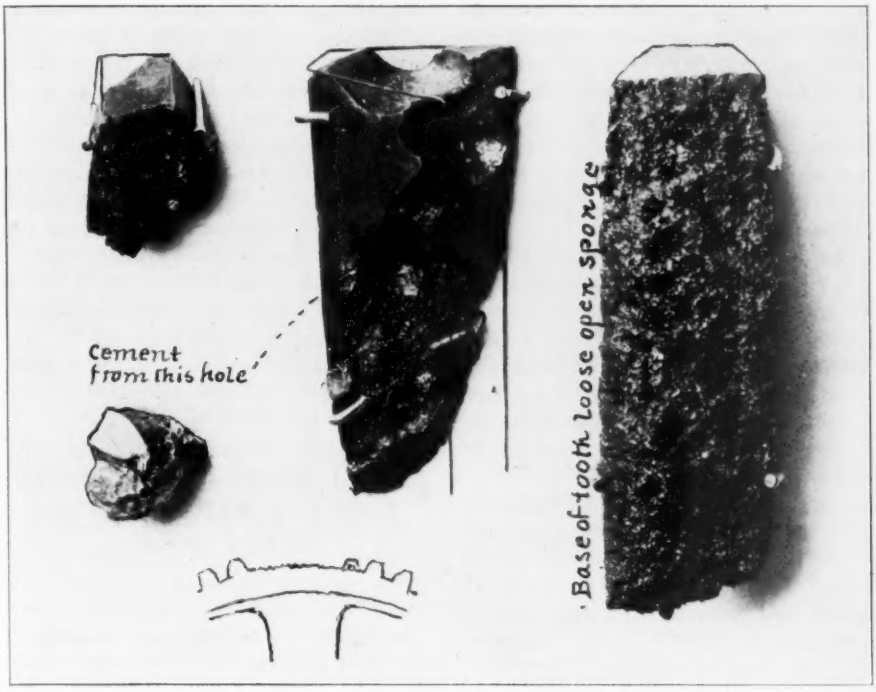
Prior to 1888 we had great difficulty in making sound cast iron gears and gear blanks, and in cutting such gears it was our custom to start the cut opposite each arm, where the defects, if they existed, would be shown, but frequently no defect would be developed until the last tooth had been cut and the wheel would have to be condemned. At that time we discovered a method of making such castings absolutely sound in the rim and thereafter

avoided condemnation of castings from that cause. We do not know what is the practice of other first class makers of gears.

Yours truly,

WM. SELLERS & CO., Inc.,
J. H. Schwacke, Manager.

The tooth of a gear is proportioned to do its work and a factor of safety is taken to meet the working conditions, but extra metal is not added to make up for possible blow holes or draw holes or for spongy metal.



BLOW HOLES IN GEAR TEETH.

We give below the chemical composition of the defective gear, together with a statement as to what the composition should have been:

Chemical determinations of defective castings were made by T. S. Ellett, chemist of the Link Belt Machinery Co., and by Prof. McCormick, of Armour Institute, Chicago, Ill., and are as follows:

Combined carbon	0.11	per cent
Silicon	2.21	per cent
Phosphorus	1.23	per cent
Sulphur	0.057	per cent
Manganese	0.46	per cent

The chemists give no opinion as to the analysis, but it is plain that nearly all of the carbon is in the graphitic state. The high phosphorus will keep the metal fluid in the mold so long that draw holes at the junction of the arm and rim would be sure to occur. The manganese is not high enough to prevent blow holes.

Mr. W. G. Scott, chemist of the G. I. Case Thrasher Co., of Racine, Wis., gives the following specifications for iron for such gears:

Silicon	1.40 to 2.00	per cent
Phosphorus below	0.70	per cent
Sulphur below	0.085	per cent
Manganese below	0.70	per cent

FOAMING SLAG.

BY N. W. SHED.

Foaming slag is something of a mystery to foundrymen. A cupola will run all right for weeks and months and

suddenly one day the slag will begin to boil and foam; sometimes the boil will be quiet the slag rising but a few feet, sometimes it will mount up to the charging door and flow over on the charging floor. At the same time a bright white flame is seen coming from the cupola stack and clouds of reddish brown smoke float away into the air. Frequently the results of foaming are harmless, the iron is but little affected though there is always a serious loss in the melted iron. But at times the iron suffers. Castings are found to be hard and brittle and in some cases the thinner castings become white. The slag, usually a light brown, becomes black and is often blown to the condition of pumice stone or has great bubbles an inch or more in diameter all through the mass. The reddish brown smoke escaping from the cupola is loaded with oxide of iron.

The phenomenon is mentioned in Mr. West's "Metallurgy of Cast Iron" but no attempt is made to explain why the cinder foams.

If the foaming slag is analyzed, the iron is found in an oxidized condition and the amount of iron is usually large ranging from 12 to 30 per cent metallic iron.

The amount of iron in a normal slag using limestone as a flux is about four per cent. The large amount of oxidized iron in the slag and the oxide of iron in the smoke show that the iron is being rapidly burned in the cupola. The low silicon, carbon and manganese in the castings show that these elements have been burned out also. The action in the cupola while the slag is foaming is very much like the action going on in a Bessemer converter when tipped a little and blow to increase the heat. The converter is tipped so that the blast of air burning the iron will give more heat to the converter. This is only done when there is danger of the steel being cold.

In the cupola the blast of air burns the iron to an oxide which is immediately taken up by the cinder, the oxygen in the cinder combines with the carbon in the melted iron forming a large amount of carbonic oxide gas which rising through the cinder makes it foam.

The unusual burning of the iron is due probably to insufficient carbon in the fuel for the amount of air in the blast. The foaming generally accompanies light poor coke and a very heavy blast.

In some cases the foaming is greater when the coke is wet. In this case there may be some decomposition of the water vapor but this is hard to prove.

From this discussion there are two ways of avoiding foaming slag. If it is possible to melt slowly then the blast may be reduced. If the melting must be done quickly then the blast may be kept on, but the coke must be increased. The evil effects of the boil may be cured by adding finely crushed silicon metal and ferro-manganese to the stream of iron as it runs from the spout.

As the foaming usually takes place while the last two or three charges are melting, it would be well to see that those charges have an extra supply of good coke and that the silicon in the iron is fairly high.

MIXING IRON BY THE RIGHT MAP.

BY JOHN MCCUNE.

The writer has been turning over this mixing by analysis problem, looking at it from one side and then from the other and trying to get some kind of a balance on it for a number of years and has found considerable difficulty in getting a correct solution for it.

Recently, however, George Ade published something in one of his European letters which throws some light on the subject. He tells of a fellow who arrived at the Victoria Hotel in what he supposed was Brussels, Belgium.

He repaired to his room, looked up his guide book and made a careful study of the city. Then, map in hand, started out, brushing by all the native guides and plunging into the mysteries of a strange city with only the map to guide him.

At first he was a little tangled and did not seem to be able to make head nor tail out of the streets. Finally he decided it was because he was holding the map wrong side up, so he turned it over and went at it again. He then hunted up an art gallery and one or two other points of interest and he noticed that some of the paintings were not labeled right and that there were a number of other minor mistakes. Such inaccuracies, however, would be expected in a book which was written by ignorant foreigners and hence he corrected his guide book and went on He wrote in marginal corrections and added several little streets to the map, which had been omitted. In the evening he returned to the hotel feeling that he had accomplished a good day's work.

At the hotel he attempted to start up a conversation with a rather frigid Englishman. After having recited several chapters of American history, personal achievements, and so on, he asked the Englishman if it was his first visit to Brussels. The Englishman replied that he had never been in Brussels. The American stated that that was just his fix, that he had never been in Brussels before. Of course, everybody knew where the carpet came from and also everybody must have heard of Brussels sprouts, etc. The Englishman then began to move away and as he went, said "Where do you think you are?" Of course, the American replied "In Brussels," and was then informed that he was in Antwerp. A short investigation proved the statement to be true and he departed hastily for the city where he had supposed that he was.

Now it appears to the writer that the foregoing story covers just what lots of fellows are trying to do with pig iron. One fellow has got a map of silicon and he is trying to find his way all over Europe by means of silicon. Another fellow has got a map of combined and graphitic carbon and thinks it is the only thing, while still others have maps of phosphorus and sulphur. The writer remembers one pig iron man who called a certain metallurgist a "siliconitis fiend," on account of the fact that he knew no other element than silicon. It may be that the fellow who only uses one kind of iron made by one furnace from one kind of ore could get along with one kind of map. But these conditions are pretty hard to fulfill under the present day practice and hence the fellow that starts to do anything will have to carry maps of all the principal elements. In one sense the writer thinks George Ade's story is not exactly a parallel case and that it might be better to consider the silicon map as a map showing the surface streets only. The sulphur map might be considered the subway system and the carbon map the elevated road system. In like manner each one of the elements might be taken as representing one of the principal features which has been taken into consideration in threading one's way through a large city. If a man knew the surface roads only and was afraid to use the rapid transit systems of the subway and the elevated, he would be placed at a decided disadvantage in comparison with those taking advantage of the more modern methods of travel.

In like manner the fellow who ties himself to silicon only limits himself to the use of certain high grade and high priced brands of iron which as far as possible eliminate difficulties arising from the presence of the elements belonging to the other map. The man who understands the whole composite map is able to take advantage of cross cuts, quick transportation methods and everything given and hence is able to do more business at a better profit and in less time than the other fellow. For my part I want all the maps I can get and then I will use those that I think I need.

A FACING MILL.

The following is an extract from a letter received from Mr. F. B. Stevens, of Detroit:

The subject of "mills" has interested a long suffering public for lo, these many years.

The "Mills" bill once interested the politicians; "The Old Mill at Newport," the historians; and "The Mills of the Gods," the students of mythology.

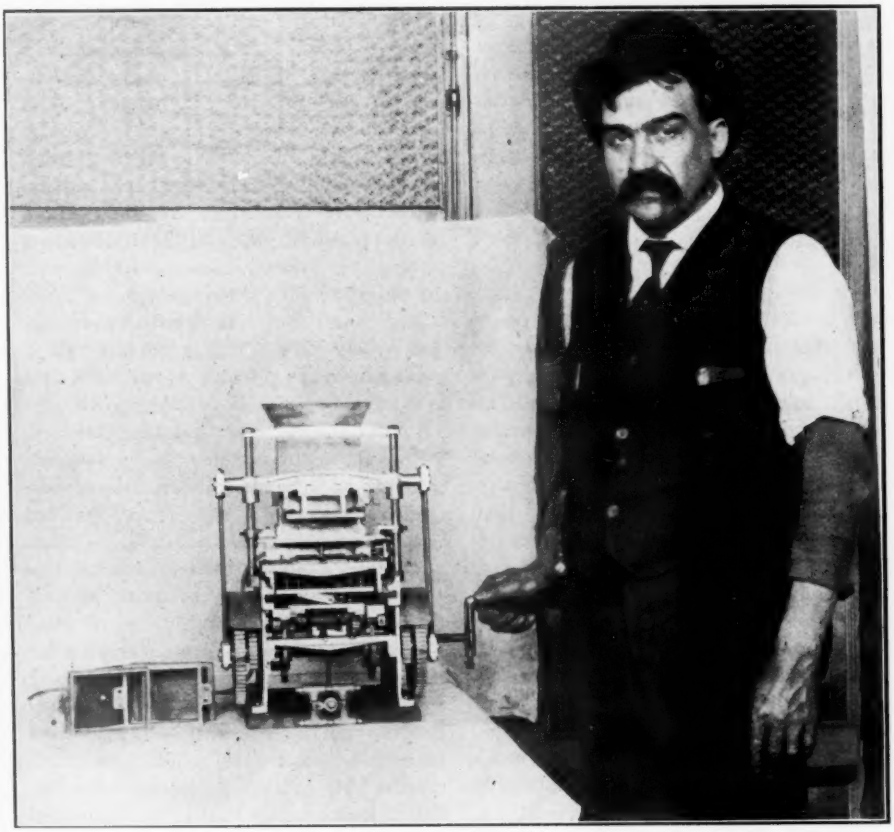
The latter "grind slowly," but my new facing mill grinds rapidly, and it should interest the foundrymen.

Detroit has needed a lot of things, but nothing more than a FOUNDRY FACING MILL.

This mill, just completed, shows a few new ideas. It is in reality, six brick buildings under one roof, all separated by twelve-inch brick fire walls. The sea coal mill is so separated that none of its dust can permeate the plumbago section; machinery takes the place of men; it is one continuous performance from the crude material to the finished product, and the journey is one of improvement all the way. I can produce more uniform product and of better quality than has been produced, merely because the most has been made of the latest improvements. Therefore, the newest facing mill MUST be the best.

A Molding Machine Model.

The accompanying illustration shows a very interesting molding machine model. The Berkshire Mfg. Co., of Cleveland manufacturer of the Berkshire molding machine, desired a small working model to be carried by the traveling salesman for demonstration purposes, and hence this model was made. It weighs but 17 pounds, and is a perfect working machine in every respect. Compressed air for operating the vibrating mechanism is supplied from a reservoir which is filled by a bicycle pump. The machine is then operated by turning a crank attached to one side.

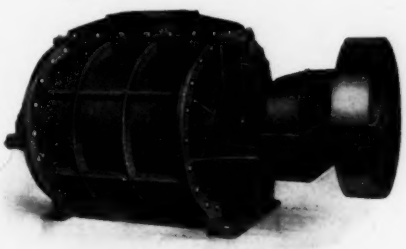


A MOLDING MACHINE MODEL.

The flask used is shown standing at the left, while a casting of a pair of ⅛-inch pipe fittings is shown leaning against the base of the machine. The mold for these castings was made on this machine and poured with white metal. Two full size machines of this type will be on exhibition at the convention of the American Foundrymen's Association, as well as the small model shown.

THE PIQUA POSITIVE FOUNDRY BLOWER.

The positive foundry blower is too well known to require a special introduction to the foundry trade, but the interest taken in this type of machine



THE PIQUA BLOWER.

is well shown by the new designs brought out during the past year and by the fact that new concerns are going into this business. The Piqua Foundry & Machine Co., of Piqua, O., has recently designed a blower which is of the well known 2-lobe type. There are a number of points of interest in this machine. First, it is designed as a short, rigid machine, which the makers claim insures greater rigidity in the shafts and parts, and consequently better work and longer wear. They also claim that by increasing the diameter and decreasing the length the leakage line is reduced.

The machine is an entirely new design and is made in both horizontal and vertical types and many sizes. The smaller machines, which are used for blowing forges, etc., are of the vertical type, while the larger machines are usually of the horizontal type, as shown in the accompanying illustration.

A New Book.

"Foundry Pattern Making," by L. Hand, published by Frederick J. Drake & Co., Chicago, Ill. Size 4½ inches x 6½ inches. 146 pages, illustrated by over 100 cuts made from original drawings by the author.

The work is bound in flexible leather and is intended for use in the shop. The author is neither a patternmaker or foundryman by trade but for many years had charge of the woodworking department of certain large manufacturing concerns, principally connected with railroads.

When one or two patterns were required they were made in the woodworking shop. Finally it was necessary to employ a patternmaker all the time, and the department gradually increased until it was finally large enough to be separated and placed under separate management. During this period, however, Mr. Hand made a special study of patternmaking and molding problems and he attacks them with the thorough originality of one who sees the problem from a different angle, than that which we are apt to look at it from.

The book contains descriptions of a great many specific examples of patternmaking and molding. The principal criticisms which might be offered are that the cuts have been reduced to such an extent that in some cases the lettering is not plain and also that in our opinion the descriptions are rather brief. We believe, however, that the book certainly has a field in shops where a regular patternmaker is not usually employed and will be found a very handy guide for those who must occasionally construct usable patterns.

The Detroit Motor Castings Co., Detroit, Mich., has been incorporated for the purpose of making brass castings and brass accessories for automobiles. The incorporators are: F. G. Skinner, R. R. Sterling, E. J. Roney, J. C. Danziger, J. Roney, and Geo. W. Bowe. Capital stock, $2,500.

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CONTENTS.

Foundry of H. W. Caldwell & Sons Co. 201
Modern Foundry Construction.... 208
Open-Hearth Steel Castings..... 211
Core Sands and Core Binders..... 216
Babbitt, The Man and the Metal 220
Getting Experience with the Brass Furnace 223
The Tumbling Barrel and Its Use 225
Brass and Bronze for the Automobile 227
Brass Foundry Notes..... 229
Multiple Core Molding..... 230
Stepped on His Corns..... 234
Cast Iron Notes..... 236
Foaming Slag 237
Mixing Iron by the Right Map.... 238
Trade Outlook 242
A. F. A. and A. F. F. Convention 244
Associations and Societies..... 247
A Low Resistance Pyrometer..... 252
Personals 259
Fires 259
New Construction 259
General Industrial Notes..... 263

Trade Outlook.

The trade outlook in the foundry field is still good. The one cloud on the horizon is the labor difficulties, and it seems that they are being settled one by one. It is reported that there is going to be a good demand for malleable castings through the summer and fall and also probably through the winter, and both the heavy and light work gray iron foundries are quite busy. Steel foundries are practically all behind with their orders, and it is exceedingly difficult to get prompt delivery on any class of steel castings. The principal trouble still seems to be that the cost of raw materials has advanced more rapidly than the price of finished castings, and hence the margin of profit is exceedingly close, and in the face of advancing labor costs it is difficult for some foundries to make both ends meet. This is especially true on long contracts which were taken at times when iron was at a lower figure.

Northern No. 2 foundry iron is quoted at $16 to $16.25 at valley furnaces, northern Bessemer at $17.25 valley furnaces, while southern No. 2 foundry is quoted at $13.75 at the furnaces.

The settlement of the labor difficulties on the lakes, with its consequent release of the ore fleet, will enable the shippers to bring down the necessary tonnage and thus allow the various furnace interests to work on foundry or Bessemer as the demand may require.

GERMAN AND AMERICAN IRON PRODUCTION.

Dr. P. Schwabach, British consul-general at Berlin, is authority for a table giving, for the past five years, the German pig iron production, the domestic consumption, and the per capita of each. It appears that while production and consumption have both grown a great deal in the five years, the per capita figures have also become much larger, the population not having grown rapidly. In 1901 per capita production was about 307 pounds and consumption about 199 pounds. In 1905 these figures had grown to 400

pounds and 263 pounds respectively. The gain in each was approximately the same, a trifle over 30 per cent, the exports increasing but slightly more than the production.

This is doing quite well, seeing that the per capita pig iron production and consumption of the whole world was in 1905 in the neighborhood of 80 pounds per capita. The three great iron countries, the United States, Germany and the United Kingdom, produce and consume the great bulk, however, the average of the rest of the world being but a comparatively small fraction of 80 pounds.

Despite the large gain shown by Germany in per capita production and consumption, the United States still keeps ahead. In 1901 the production of pig iron per capita in the United States was about 457 pounds, and domestic consumption about 435 pounds. In 1905 the production was about 620 pounds and the consumption about 575 pounds. Consumption increased a trifle more than 30 per cent, as it did 35 per cent, showing a greater gain than Germany. The gain in total production was, of course, much greater, as our population is increasing much more rapidly.

Details are lacking as to how the figures for Germany were made up. Those given here for the United States take account of all imports and exports, having regard not to their own weight but to the weight of the pig iron required to make them.

THE BOOM IN METALS.

The present boom in tin, lead and antimony will be remembered in the trade beyond the present generation. Tin and antimony have this week, May 17, reached by far the highest prices on record, while lead and copper are at the present time not far from making records.

In the amount of the proportionate advance, antimony has easily taken the lead. At the time of this writing Cookson's antimony in ordinary lots is held at 26½ cents. A year ago it sold at 9 cents, so that in one year this metal has practically tripled in value. No price like the present has ever been attained before.

The present price of tin is the highest on record. Taking London prices, as the London statistics can be carried further back, tin closed Monday of this week in London at £215 for spot. Statistics beginning with 1850 show the following swings:

1850,	low	£70
1857,	high	150
1866,	low	75
1872,	high	160
1878,	low	*52½
1882,	high	114
1884,	low	73
1888,	high	†170
1896,	low	56
1906,	high	215

*Lowest in history.
†Secretan syndicate.

The memory of the famous Secretan syndicate, which collapsed in January, 1888, is still fresh in the minds of the older metal men. Until now it has marked the highest price ever reached for pig tin. M. Secretan and his associates endeavored to corner copper and tin. The copper corner burst first and tin necessarily followed. M. Secretan blew his brains out. A large increase in the visible supply of tin occurred as the corner progressed, the invisible supply being converted into visible. A year afterwards the visible supply had become perfectly normal. What manipulation is connected with the present advance is of a totally different character. There is no cut and dried effort at a corner. Late last year the leading operators began pulling strictly together, but last March one of the largest operators was found to be heavily short for April, and a squeeze resulted. Where it will end no one can say.

There is, of course, scarcely any market for tin at the moment, and it will require a continuance of present prices for a little while before the manufacturing industries actually find themselves using such high priced tin. The time will unquestionably come, however, as it is certain that there will be no collapse. Tin will either advance further, or will decline but gradually.

The present movement in tin is a continuance of one which began in June, 1904, when tin almost touched 36 cents in New York. Following the boom of 1899-1900, when 33 cents was almost reached, there had been numerous fluctuations, all between 23 and 30 cents.

As the consuming trade does not deal with record prices but with averages, the following table of average monthly prices for the past 13 months is given, the averages being those of the daily closing prices for spot Straits tin, 5-ton lots and over:

April, 1905	30.62
May	30.16
June	30.41
July	31.78
August	32.97
September	32.16
October	32.55
November	33.50
December, 1905	35.85
January, 1906	36.49
February	36.48
March	36.64
April,	38.90
May 14, 1906	49.50

The advance will fall very heavily on the tin plate manufacturers. In August last the minimum net price of tin plate was $3.25, with tin under 33 cents. The present official price is but 30 cents higher, yet the advance in tin is 16½c, equal to more than 35 cents per box of tin plate. All three of the advances in tin plate to the present found full justification in the advance in steel; there was nothing left with which to pay for higher tin.

Copper has not reached the high point of last December, when 20 cents was touched, but it is now within a cent or so of that figure. The sensational advance to a trifle over 18½ cents, in 1899, is left in the shade.

Consumers of iron and steel products must view with much satisfaction the steady market which has prevailed in these lines. It is well recognized that prices have been kept so steady largely by the efforts of leading interests in the trade, and with the example of these metals in view no one will grudge to place credit where it is due.

CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION AND THE ASSOCIATED FOUNDRY FOREMEN.

As previously announced in THE FOUNDRY, these two societies will meet in Cleveland for their annual convention on June 4 to 7. This bids fair to be the largest and best attended, as well as the most interesting of the conventions thus far held. It is reported that there will be one or two carloads come from Chicago, two or three from Pittsburg, and similar parties from Philadelphia and New England. There will also be a very large attendance of those who come singly or in small parties as usual. Arrangements for special transportation rates have been made on the usual certificate plan. That is, when purchasing a ticket to the convention the purchaser secures a full rate ticket to Cleveland and also a certificate stating that he has purchased such a ticket, and is entitled to a special delegate's return ticket for one-third fare. These certificates are then turned in at the headquarters of the railroad in Cleveland, countersigned by the railroad agent and returned to their respective owners. The certificate will then entitle the owner to the purchase of a one-third fare return ticket. It is hoped that all parties attending the convention will secure certificates whether they expect to return by the same route or not, as it is necessary to secure 100 certificates to make the arrangement binding with the railroad company.

An unusually good list of papers is to be presented at the meeting. Among those already received are the following: "The Beneficial Effects of Adding High Grade Ferro Silicon to Cast Iron," by Alex. E. Outerbridge Jr. "Molding Problems," by David Spence. "Electricity in the Foundry," by F. L. Antisell. "Developments in the Thermit Process in Foundry Practice," by W. M. Carr. "Dark Secrets in Foundry Practice," by Wm. H. Parry. "Uniform Practice in Foundry Cost Finding," by

Kenneth Falconer. "Manufacture of Soil Pipe and Fittings," by T. J. Best. "Foundry Tests of Coke Made by the U. S. Fuel Testing Plant," by Dr. Richard Moldenke. The report of the committee on "Standard Methods for Analysis of Iron," "Good Molders, Why They are Scarce," by W. S. McQuilliam. "A Talk on Alloys," by C. Vickers. "Correct Application of True Burden to Iron Cost," by E. M. Taylor. "Core Binders," by A. M. Louden. "Multiple Molding," by Jas. F. Webb. "Pattern Shop Equipment," a joint paper prepared by the members of the Cleveland Patternmakers' Association. "Sanitary Appliances for the Foundry," by H. M. Lane. "Air Furnace Construction and Operation," by Ralph H. West. "Tests of Cast Iron," by Prof. C. H. Benjamin. Several other papers are promised and will undoubtedly be received in time for the convention.

The entertainment program as laid out consists of a theater party on Tuesday evening, an automobile ride for the ladies on Wednesday afternoon, a visit to some factories in Cleveland by the gentlemen at the same time, and a visit to one of Cleveland's pleasure resorts on Wednesday evening. A steam boat ride to Lorain, including a visit to the ore docks, blast furnaces and foundry on Thursday, and a smoker on Thursday evening.

The sessions of the convention will be as follows: The Associated Foundry Foremen will hold their business session on Monday evening, June 4. The American Foundrymen's Association will hold their business session on Tuesday morning, June 5. The balance of the morning and the afternoon of Tuesday will be devoted to the reading of papers and the inspection of exhibits of foundry supplies and equipment. There will probably be two sessions on Wednesday for the reading of papers and sessions on the boat on Thursday. The patternmaking papers will probably be read on the boat and it is also likely that the cost papers will be read on the boat.

Special arrangements are being made to take care of the ladies during the convention, and it is hoped that a large number of those attending will bring their wives and daughters.

Exhibit of Foundry Supplies and Equipment.

The most unique feature in connection with the convention is to be the exhibit. The convention will be held in the Central Armory. This is two blocks north of the Hollenden Hotel, where the A. F. A. headquarters will be held and seven blocks from the American House, where the A. F. F. headquarters will be held.

The armory is a building 120 x 207 feet. The speaker's stand will be located in the center, as indicated by the accompanying diagram, and the seats arranged in a rectangle next to the speaker's stand. The balance of the room will be taken up by exhibits. A list of those for which space had been selected at the time the accompanying cut was made is given below. In addition to these several other firms have contracted for space since. A 55-horsepower gas engine will be installed in one of the exhibits, and will operate an air compressor, and a line of shafting. The shafting will drive a series of power exhibits while the air compressor will serve to furnish compressed air for six exhibits containing pneumatic appliances and tools, mostly pneumatic molding machines.

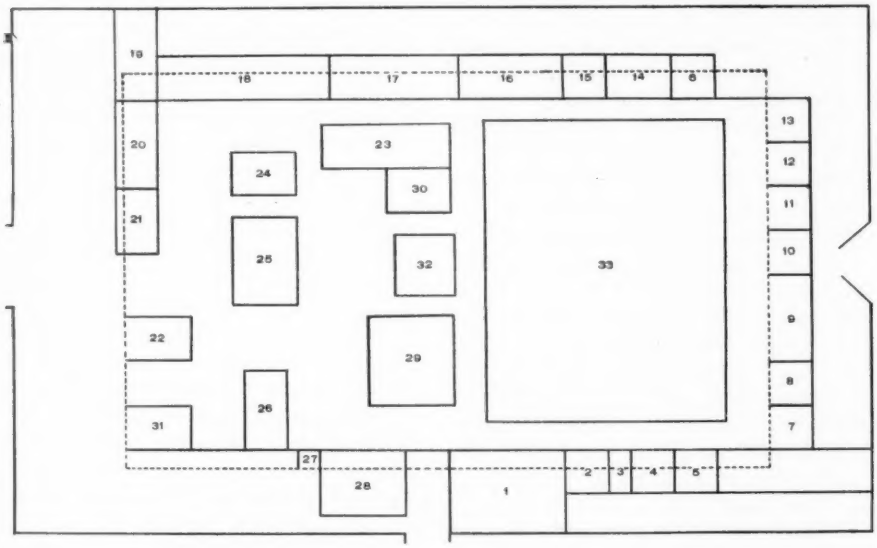
In addition there will be daily demonstrations of the thermit processs and of the electric lifting magnet made by the Electric Controller & Supply Co. There will be a number of exhibits of pattern shop supplies and equipment. In fact, one could equip an entire foundry by consulting the representatives of the various exhibits on the floor.

It is hoped that all who intend to be present at the convention will notify either the reception committee, whose headquarters are at 610 Schofield Building, Cleveland, or THE FOUNDRY.

The following is a key to the arrangement of the exhibits in the armory. This building is 120 x 207 feet, and the entrance is on the side next to 1.

1. Berkshire Mfg. Co.—Molding machines in operation.

2. Detroit Fdry. Supply Co.
3. The Diamond Clamp & Flask Co.
4. W. W. Lindsay.
5. Interstate Sand Co.
6. The American Sand Co.
7. The McPhail Molding Machine Co.—(in operation.)
8. Chisholm & Moore.
9. Arcade Mfg. Co.—Molding machines in operation.
10. Headquarters Desk.
11. Cleveland Wire Spring Co., foundry barrels and tote boxes.
12. THE FOUNDRY.



13. The Western Foundry Supply Co.
14. B. F. Sturtevant Co.
15. The Holland Linseed Oil Co.—(making cores).
16. Falls Rivet & Machine Co. (Will have the Wadsworth Core Machine and other devices in operation.)
17. The Standard Sand & Mch. Co.—(in operation).
18. W. W. Sly Mfg. Co.—(Tumbling Mills and Dust Arrester in operation).
19. The Bruce-Meriam-Abbott Gas Engine Co.—(A 55-horsepower gas engine in this exhibit will supply power for driving the adjacent line of exhibits from line shafting, and also for driving an air compressor for furnishing compressed air to various exhibits.
20. Chicago Pneumatic Tool Co. (Will have an air compressor and various pneumatic tools in operation.)
21. The Tabor Mfg. Co. Molding machines in operation.
22. The Herman Pneumatic Molding Mch. Co. (Will have a large molding machine in operation in connection with pneumatic hoist for lifting off the molds.)
23. The Atlas Car & Mfg. Co. (Industrial railway cars, turn-tables, etc.)
24. The Crescent Mch. Co. (Pattern making equipment.)
25. The Goldschmidt Thermit Co. (Daily exhibit will be given illustrating the use of thermit for various purposes.)
26. The Electric Controller & Supply Co. (This company will have on exhibition one of its large electric lifting magnets in operation, and also an arc welder.)
27. Wm. Dobson—Molders' tools.
28. The J. D. Smith Fdry. & Supply Co. (A general exhibit of foundry supplies and equipment.)
29. The Osborn Mfg. Co. (Foundry equipment.)
30. Whiting Foundry & Equipment Co.
31. E. H. Mumford & Co. (Molding machines in operation.)
32. The speakers' stand.
33. Space for seats in the convention.
34. The Connersville Blower Co.

In addition to the above there are

several exhibits, for which contracts have not as yet been signed, which will take up practically all of the balance of the available space.

Special Car From Chicago to Cleveland.

Mr. Geo. H. Griffiths, western representative of The Penton Publishing Co., whose address is 1164 Monadnock Block, Chicago, Ill., is arranging for a party to start from Chicago on Sunday evening, June 3, to attend the American Foundrymen's Association convention in Cleveland June 4 to 7.

A Correction.

In the May issue of THE FOUNDRY, on page 191, we described a molding machine under the caption "A Handy Molding Machine," but failed to state that it was made by the J. W. Paxson Co., of Philadelphia. It is evident that this notice was observed, as we have received several letters about it and have referred all of the parties to the J. W. Paxson Co.

ASSOCIATIONS AND SOCIETIES.

New England Foundrymen's Association.

Fred F. Stockwell, Secretary, Care of the Barbour-Stockwell Co., Cambridgeport, Mass.

The regular monthly meeting of the New England Foundrymen's Association was held at the Exchange Club, Boston, on Wednesday evening, May 9. Dinner was served at six o'clock, after which the routine business was disposed of in the usual manner, with President W. B. Snow in the chair.

Attention was called to the convention of the American Foundrymen's Association to be held in Cleveland on June 5, 6 and 7, and the members were urged to send a full representation from New England. The chairman appointed Messrs. Magee, Shaw and Stockwell a committee to make arrangements for attending the convention.

Announcement was made that the next meeting of the association would be held in the way of an outing at the Point Shirley Club, Winthrop, Mass. The president then introduced as the speaker of the evening, E. M. Taylor, of the Library Bureau, Boston, who discussed in a practical way "The Correct Application of True Burden to Iron Costs."

Philadelphia Foundrymen's Association

Howard Evans, Secretary, care J.W. Paxson Co.

The monthly meeting of the Philadelphia Foundrymen's Association, which was held at the Manufacturers' Club on the evening of May 2, was marked by an unusually interesting discussion of the very unsatisfactory labor conditions that prevail in so many of the foundries of the country. The matter was brought up by the reading by A. A. Miller of the following communication on the subject, with suggestions for a remedy, from William Cook, foreman of the Haines, Jones & Cadbury Co.'s foundry at Norristown, Pa.:

"A great question has come up before the Foundry Foremen's Association, which has puzzled every manufacturer in the iron business, superintendent and foreman, and which has been the cause of the loss of many thousands of dollars. I know by my own experience the difficulties we have suffered in filling our contracts in the time limit, some even having been canceled.

"This was caused by our hoboes or floating labor. I have experienced great difficulty when the firm I was with made a contract to deliver material within a certain time set by the superintendent and myself, which involved thousands of dollars and which through hoboes and floating labor we were unable to fulfill. The firm would then complain because the foreman had not employed steady men, when, if the truth were known, he had to take whomever he could get because work was plentiful and all good men had steady jobs.

"I have an idea which I have been

studying for some time and which I feel it is my duty to make public for the benefit of the manufacturers. My idea is to have the association provide ways and means to teach apprentices in a good thorough course of whatever class of work they prefer. I do not think it would take many years to do away with our hoboes and floating labor. I think a fund should be started by the manufacturers to establish a foundry and divide it into the several departments: stove department, steel department, machine department, plumbers' supply department and a brass department. This should be called a foundry institution. The management of this should be under one superintendent. The manufacturers should vest in him the power to obtain a first-class mechanic or foreman for each department and to see that they received into their departments only apprentices who would learn the trade properly and be a benefit to it. The time for the youths to serve I would leave to the association to decide, but I think it should be not less than four years. Each apprentice should be fairly well educated. There should be nothing but marketable goods manufactured, and the disposing of the goods should be left to the association or to a committee formed for that purpose.

I think it would only be a matter of a few years, say, two or three, before this would pay for itself. This would be one of the greatest benefits to the manufacturer, for in a few years he would have skilled, intelligent mechanics. In the course of ten years you would find very few hobo molders, for when each apprentice has served faithfully and honorably, he should be given a diploma and should be given preference when he applies for work at other foundries.

"Now, gentlemen, I have only given you my idea, which is open to amendment and improvement, for many heads are better than one. I have merely given you the key to my own idea, and I hope you will take the matter up and give it serious consideration, for the time will come sooner or later when something will have to be done, because skilled labor has become necessary both to the business and welfare of the country."

In the discussion which followed the reading of the paper, Mr. Cook's suggestion of a school for apprentices was not seriously considered, but general complaint was made of the character of much of the labor employed in foundries, and the matter was generally conceded to be a very serious one. W. O. Steele said that the question was one which was under constant discussion by the Foundry Foremen's Association, and W. A. Perrine, after giving at some length his own experiences, said he could suggest no remedy except the better education of molders. D. G. Moore said his company at Elizabethport, N. J., had tried the plans of bonuses for men who would work steadily every day, having set aside as much as $3,000 a year for this purpose, but without much success. One reason for existing troubles he thought was that the men made too much money. When they made enough in three or four days to live on, they were unwilling to work the rest of the time.

H. O. Evans contended that the manufacturers were much to blame, as the men were generally compelled to work in dirty, ill-lighted shops, where no attention was paid to their comfort or to lightening their burden in the handling of the sand. Brighter shops and more welfare work he thought would do much to cure present evils. This view was controverted by another speaker, who referred to a bright cheerful shop where the men still kicked and frequently stayed away from work.

W. J. Shannon, of the Bethlehem Steel Co., spoke of the difficulty of securing good men in the country because of the lack of amusements, and believed that the best way to hold them was by interesting them in the purchase of a home. P. D. Warner, of Reading, also spoke.

It was agreed by all the speakers

that it was difficult to get good apprentices, and that the class of boys taking up the trade of molding was much inferior to those of 25 or 30 years ago. So much interest was aroused by the discussion that it was generally agreed that it would be well to devote a future meeting to a more careful consideration of the whole matter.

The association voted $100 for the relief of the San Francisco sufferers, and Secretary Evans announced that, through the association as a medium, some three or four members had contributed some $500 to the same cause, while many other members had assisted through various relief funds. After some discussion of inviting the American Foundrymen's Association to hold its 1907 convention in Philadelphia it was decided that separate invitations should be extended by the local organizations of foundrymen and foundry foremen to the two national bodies, but that committees of the two Philadelphia associations should co-operate in entertaining the delegates. R. H. Day, of Day Bros., was elected a new member.

The technical paper of the evening was read by Harry D. Harvey, of the Monarch Engineering & Mfg. Co., of Baltimore, on "The Steele-Harvey Crucible Melting Furnaces for Brass Foundry Practice, Using Oil or Gas for Fuel."

Pittsbug Foundrymen's Association.

F. H. Zimmers, Secretary, Care Union Foundry and Machine Co., West Carson Street.

The May meeting of the Pittsburg Foundrymen's Association on Monday evening, May 10, took the form of a course of instruction and inspection in car wheel molding when the members of the association to the number of forty, as guests of W. C. Connelly of the Pennsylvania Car Wheel Co., visited the plant of that company in Allegheny and spent a profitable as well as an enjoyable evening.

Under the guidance of Mr. Connelly the foundrymen witnessed the operation of the Pennsylvania Car Wheel Co.'s machine for molding car wheels, the only machine of its kind in the country, and having a capacity of 570 finished wheels per day. It is operated almost entirely by unskilled labor and as a labor saving device is considered one of the most economical in the foundry business. After the visit to the car wheel works a delightful lunch was served. Secretary F. H. Zimmers, of the association, urged upon the members the importance of Pittsburg turning out a full attendance at the annual convention of the American Foundrymen's convention in Cleveland, June 4-7. The Pittsburgers contemplate engaging a special car and attending the convention about 75 strong. Members of the National Foundrymen's Association were also impressed with the importance of attending the meeting in Chicago next Saturday.

Philadelphia Foundry Foremen.

John B. MacMeekin, The Abram Cox Stove Co., Secretary.

The regular monthly meeting was held on May 14, and was well attended.

The subject of the education of apprentices in the foundry was discussed fully and much interest expressed in the subject. At the June meeting it has been decided to consider the subject "Ways and Means to Encourage Men to Work More Steadily."

Mr. J. B. MacMeekin, of the Abram Cox Stove Company, Philadelphia, was elected delegate to attend the Associated Foundry Foremen's meeting in Cleveland, and Mr. W. O. Steele, of The Bateman Manufacturing Company, of Grenlock, N. J., was elected alternate.

Pacific Coast Foundrymen's Association.

J. D. Morris, Secretary and Treasurer, Seattle, Washington.

This organization was founded some time ago and now comprises twenty-three firms, and will probably have several others among its membership before long. While the organization was formed primarily for business purposes, it is also intended to have papers read and discussed and to do everything possible for the advancement of good foundry practice on the Pacific coast.

The editor of THE FOUNDRY had the pleasure of living in the Evergreen state for some time, and knows that it is a land of wonderful opportunity and that the foundrymen of the northwest are to be envied for their position on the frontier where progress and development go forward so rapidly. We certainly wish the Pacific Coast Foundrymen's Association every possible success, particularly in regard to its educational side, as that is the phase which THE FOUNDRY is especially interested in.

Cleveland Foundry Foremen.

H. M. Lane, Browning Bldg., Secretary.

The Cleveland Foundry Foremen's Association has held two meetings during the past month, both of which were devoted entirely to the discussion of matters relative to the coming convention of the A. F. A. and the A. F. F. Various committees have been appointed and everything possible has been done to take care of the guests who come to the convention.

BUFFALO FOUNDRYMEN'S ASSOCIATION.
John E. Gorss, Secretary, 23 Builders' Exchange.

THE ASSOCIATED FOUNDRY FOREMEN.
Frank C. Everitt, care the J. L. Mott Iron Works, Trenton, N. J., Secretary.

NEW YORK FOUNDRY FOREMEN'S ASSOCIATION.
C. H. Thomas, 14 Elizabeth St., So. Norwalk, Conn., District Vice President.

ERIE FOUNDRY FOREMEN.
W. F. Grunau, Dist. Vice Pres., care Erie City Iron Works.

CHICAGO FOUNDRY FOREMEN.
Mr. Thompson, Link Belt Co., District Vice Pres.

MILWAUKEE FOUNDRY FOREMEN
Sol. Shaw, care Clinton Street Foundry of Allis-Chalmers Co., Secretary.

MONTREAL FOUNDRY FOREMEN.
Mr. J. F. Gaffney, care of Allis-Chalmers Bullock Co.

CINCINNATI FOUNDRY FOREMEN.
E. W. Cadwell, Secretary, care S. C. Tatum Co.

INDIANAPOLIS FOUNDRY FOREMEN.
W. S. Keller, of Hetherington & Berner Co., District Vice President.

HAMILTON, ONT., FOUNDRY FOREMEN'S ASSOCIATION.
A. Chase, care Sawyer & Massey Co., Secretary and Treasurer.

BRITISH FOUNDRY NOTES. A NEW BRANCH IN BIRMINGHAM.

The British Foundrymen's Association, having established a strong central organization is at present employed in the establishment of branches, and the movement has met with some success. The most recently formed is the Birmingham branch, the inaugural meeting of which took place on April 28 at the Technical School, Suffolk street, Birmingham, under the presidency of Mr. A. H. Hiorns, the head of the metallurgical department of the Technical Schools. About thirty foundrymen, all engaged in important establishments in the district, were present. It is one of the first principles of the association that no opportunity of technical study shall be missed, and the business part of the meeting was therefore followed by a paper from the president, Mr. R. Buchanan on the subject of "Mixing, Melting and Cooling Cast Iron."

The chairman expressed his great satisfaction at the formation of the Birmingham branch. A New Zealand visitor to the school lately assured him that smithing was the most important of all trades. That gentleman happened to be the head of the smithing department in New Zealand. Of course, they did not like to contradict Colonials, who were apt to get rather conceited, because in the colonies they did not meet their own equals, but iron foundry was surely more important, and many trades could not exist without it.

It was now possible to approximate to finality, and he was very pleased to find the foundrymen studying the scientific aspect of their craft. It was all very well to work in the old days by the "Rule of Thumb" but those

days were passing away, and they could only keep on a level with foreign nations by such study. They might congratulate themselves that if they went to Germany they would not find that country very much superior to themselves. In introducing the lecturer, the chairman described Mr. R. Buchanan as a past master on foundry subjects.

Mr. Buchanan gave some particulars of the association, which, he said, had been in existence about two and a half years, during which time he had had the honor of being president. The association was founded from mixed motives. One motive was the deep and great love for the subject itself, a love inculcated in himself by the chairman during his student days. He counted it one of the great privileges of his life to have been a student for several sessions at that magnificent school, towards which he should always entertain feelings of the warmest gratitude. (Applause.) A second motive was the desire to extend to others some of the knowledge he himself had gained. Britishers should never recognize any people in the world as their superiors, either in industry or science, so long as any effort on their part could bring them into line with them. (Applause.) Neither personally or nationally did he believe in taking his lickings lying down. The recognized that certain people were possibly getting in front of them in certain directions, especially on the scientific side, and for the well-being of the country that condition should not be perpetuated. They had a very long row to hoe in foundry education. They could not continue to work on the old lines, and the spread of that knowledge would be a great boon to the industry of the country. A third motive was the knowledge that such practical use could be made of that study by ambitious men that they would climb up to success. There was lots of room at the top for the ambitious young chap who meant to get there, and employers were on the lookout for young, ambitious, and able fellows determined not to stop at the bottom. One of the gratifying features connected with the association was that the employers were recognizing the live men in the association, and one of their members who would not have been regarded as a likely man to get such an important position, had within the last few weeks become the head of a most important foundry. That association had largely contributed to his success. Employers had great difficulty in finding first class men, and there were more big jobs looking after good men, than good men looking after good jobs. The employers were only too happy if they could find men ably and efficiently to fill the responsible positions, and they were looking for that association to supply them. They wanted all the able young fellows in the district to join them, and they would try to build up each other's characters and efficiency as well as the industry in which they were engaged. (Applause.)

Mr. Buchanan then proceeded to deliver his lecture. He regretted that in buying iron most founders still bought as their fathers did by fracture, which was only a very insufficient criterion of character, often misleading foundrymen and getting them into trouble. Then their confidence in certain brands of iron was so unbounded that they blamed everything but the iron. Certainly anybody who had tested by analysis would never dream of going back to fracture. The pig dealers always took care that the worst of the iron was pushed onto people who did not analyze. In regard to hematite there was no brand more unreliable in respect to sulphur contents. It might carry more sulphur than cinder pig. The lecture contained a large amount of information of much technical value, and the lecture concluded with an interesting series of views showing the different cupolas in use from ancient times until the present day. He also gave an analysis of some of the iron taken from James Watt's first pumping engine.

A discussion followed, in which Messrs. F. J. Cooke, the Honorable Local Secretary F. W. Finch, Honorable Local Secretary Mason, and oth-

ers took part. Mr. Buchanan acknowledging a vote of thanks, said that at the first conference they had eighty-four members, next year they reached a hundred, and the total at the present time was 135 members. He thought they were making very satisfactory progress.

Following the meeting a number of the visitors joined the roll of membership and bids fair to be a strong one. The meetings, which are to be purely educational, are to be held monthly at the Technical School during April and May, and from October to February of each year, visits also being made to works of interest as circumstances permit. The next paper is to be read by Mr. A. H. Hiorns, the head of the metallurgical department, Birmingham Technical School, the subject being "Effects of Some Chemical Elements On Cast Iron."

Notes.

Mr. Samuel Leveridge, a well known Wolverhampton iron founder who died recently, has left a fortune valued at £615,892 gross and £564,383 net. Probate of the will has been granted to his sons Mr. Samuel Leveridge, of Bishton Hall, Wolverhampton. The large estate is practically all divided among the surviving members of his family, with the exception of a few small gifts to local hospitals and legacies to old servants.

A LOW RESISTANCE THERMO-ELECTRIC PYROMETER AND COMPENSATOR.[1]

BY WM. H. BRISTOL.

For a great variety of industrial processes and also in scientific research the ranges of temperature required do not exceed 2,000 degrees Fahr. The low resistance pyrometer herein described has been developed to meet the existing demand for an instrument to fully cover this range of temperature; one which would be accurate, reliable and comparatively inexpensive, taking into consideration both the initial cost and the cost of maintenance; also one that might be readily adapted to varying conditions for industrial operations and be successfully operated by an ordinary workman.

FIG. I.—WALL TYPE, THERMO-ELECTRIC PYROMETER.

As the title implies, this pyrometer depends primarily upon the well-

[1] Presented at the January 1906 reunion in New York City and re-presented at the Chattanooga meeting (May 1906) of the American Society of Mechanical Engineers.

known thermo-electric couple, consisting of two dissimilar metals or alloys joined at one end. When the junction of such a couple is located at a point where the temperature is to be measured, an electro-motive force is developed, which is a function of and depends for its value upon the difference of temperature at the junction and that at the opposite or so-called cold ends of the two elements forming the couple.

At the present time many of these couples are successfully employed for the determination of high temperatures. They are almost invariably used in conjunction with an extremely delicate high resistance galvanometer, which, according to Le Chatelier, is indispensable, 200 ohms being mentioned as a minimum resistance allowable in the indicating instrument. This amount of resistance is necessary to practically eliminate the atmospheric temperature influence upon the resistance of the elements forming the couple, the leads and the coils of the galvanometer itself. If the galvanometer be of a high resistance type it is evident, that if sensitive to the minute current of electricity corresponding to the very low electro-motive force produced by the couple, it must be delicately constructed and consequently requires great skill and care in its handling and operation. The sensitive coil of the instrument is usually suspended by an extremely fine wire and the instrument must always be leveled and located upon a solid foundation before observations can be made.

The platinum-rhodium couple instrument above described may be classed as a high resistance pyrometer when compared with the low-resistance pyrometer of which the following is a description: It consists of three parts: couple, indicator and leads to connect couple and indicator. The leads between the couple and the indicator may be of almost any desired length to meet the special requirements, the combined resistance of the leads, couples and indicator are fixed to suit the total range of the instrument and varies from 3 ohms as a minimum to 10 as a maximum. The indicator is a low-resistance instrument of special design, and is made especially for the writer by the Weston Electrical Instrument Co. The accuracy, permanency, and portability of these instruments is well known.

Fig. 1 shows a wall or switch-board form of the indicator. Fig. 2 illustrates a portable form. These indicators are made with pivots in jeweled bearings in place of the delicate suspension by fine wires which are generally considered necessary in the high resistance type of indicator or galvanometer for this work. The elements used in the low-resistance system give a much greater electro-motive force than the platinum-rhodium couple, which is a great advantage in gain of motive power for the operation of the indicating instrument.

The particular metals or alloys applicable for a pyrometer of this type should have a fusing point higher than the maximum temperature to be measured; and when formed into a couple should produce a high electro-motive force with practically uniform increase of same proportional to the increase of temperature. As the result of many experiments with different metals and alloys to determine suitable materials to meet these requirements, couples have been finally adopted which consist of alloys of tungsten, steel, nickel, iron and copper; different alloys being employed to suit the total ranges of temperature that it is desired to have the scale cover.

Since no rare metals are used for the couples, this part of the pyrometer is inexpensive and it is possible to employ elements of large cross-section, which will not be affected in their resistance any appreciable amount by the variation of temperature along the lengths of the elements forming the couple. The leads to the indicator are made of flexible insulated copper duplex cable and of ample cross-section to practically eliminate the influence of variations of atmospheric temperature. The cross-section of the elements of the couple is reduced

at their junction, thus rendering it sensitive to sudden changes of the temperature to be measured.

A novel feature of the couple is that it is made separable at the point where it passes through the wall of the space within which the temperature is to be measured. The object of the joint is two-fold: first, to make it possible to renew the "Fire-end" whenever it may be necessary; and second, to permit carrying the cold ends of the elements to a point toward the floor where the atmospheric temperature will be constant and not influenced by the temperature that is being measured. Fig. 3 shows a complete element with separable joint, coiled leads and lamp plug on the end of the cable forming the leads for convenient connection to the indicating instrument shown in Fig. 1.

A special feature of the joint is that it is provided with large bearing surfaces to prevent possibilities of variations of resistance at the connection and is constructed to allow for easily breaking and making the connection. The details of the joint are shown clearly in Fig. 4, and from this it will be seen that it is impossible to make the connection incorrectly, as is usually done when there is nothing to guard against it.

The low cost of the couples makes it practicable for the user of the instrument to keep an extra fire-end in reserve, which may, at any time, be quickly substituted for the one that has been in continual service, thus affording an economical and positive check upon the accuracy of the instrument.

The elements of the couple are independently insulated in a novel and effective manner by winding each with asbestos cord and then coating the surface with carborundum paint, a solution of silicate of soda being used as a binder. This makes a clean, compact and smooth insulation. Couples thus insulated are flexible and can either be applied to the heated space directly or they may be inserted into a piece of ordinary pipe as a protection. This protection has proven itself to be effective and economical. For continuous applications of the couples to temperatures in the neighborhood of 2,000 degrees Fahr. or over, special protecting tubes of nickel, plumbago or porcelain are employed.

FIG. 2.—PORTABLE TYPE, THERMO-ELECTRIC PYROMETER.

These pyrometers are furnished with scales for total ranges of 600, 1,200, 2,000 and 2,600 degrees Fahr. Reproductions of these scales are shown in Fig. 5. The graduations of these scales are determined by the fusing temperatures of lead, zinc, aluminum and copper, which give sufficient points on the curves for use in making a complete graduation of the scales. The divisions are also further checked by the use of a standardized Le Chatelier platinum-rhodium couple, and a Siemens-Halske suspension galvanometer. For very open scales over shorter ranges several couples may be placed in series, thus making it possible to read to small fractions of a degree.

FIG. 3.—COMPLETE ELEMENT OF THERMO-ELECTRIC PYROMETER.

A novel application of the thermo-electric couple is that of determining the temperature of molten metals, as cast iron, copper, brass and bronze. It consists in leaving the ends of the elements disconnected and without insulation. When these ends are slightly immersed in the molten metal it makes a junction between the elements and the reading will be same as if the elements of the couple had been originally joined. The advantage of this plan is that the reduced cross-section at the ends of the couple allows it to almost instantaneously attain the temperature of the molten metal, consequently there is no lag error—a most important advantage. As the couple is used over and over again, the ends become worn away, but the couple is, nevertheless, always ready for use by immersion of a fresh portion, which will not be changed in any way by continued use and will give the same reading for a given temperature as if the couple had not been worn away. A joint is provided near the end that is immersed so that a fresh tip can be applied to the couple before enough of the end has worn away to appreciably affect the resistance of the complete system.

Compensators.

As already mentioned, it is well known that the electro-motive force generated by a thermo-electric force generated by a thermo-electric couple is a function of the temperatures at the hot and cold ends.

For refined measurements it is therefore necessary to make allowance for changes of temperature at the cold ends of the couple when readings are taken unless some means is provided to maintain them at a constant temperature. This is sometimes done by immersing the cold ends in ice water or by having a water jacket around the ends through which there is a flow of water at some known temperature.

FIG. 4.—SEPARABLE JOINT FOR THERMO-ELECTRIC PYROMETER.

In the low-resistance thermo-electric pyrometer system, comparatively small changes in the actual resistance of the circuit including couple, leads and instrument will produce sufficient effect to correct for atmospheric changes at their cold ends. A compensating device to automatically correct for changes of atmospheric temperatures at their cold ends has been devised

which makes it possible to dispense with the cumbersome means for maintaining the cold ends at constant temperature or the necessity of taking readings of temperatures at the cold ends.

This compensating device is shown in Fig. 6. It consists of a glass bulb with a short stem, similar to an ordinary mercurial thermometer. Two platinum terminal wires are fused into the stem near its top. These are connected within the bore of the stem by a loop of fine platinum wire, thus completing the circuit as indicated in the diagram. The size of the bulb, the cross-section of the bore of the stem, and the cross-section of the platinum wire loop are proportioned to suit the case in hand.

The compensator will perfectly compensate for any particular point on the scale, as, for instance, the working point, where it may be desired that the reading shall be absolutely independent of changes of temperature at the cold ends. It will readily be seen that if the temperature rises at the cold ends the mercury rising in the stem will short-circuit a certain portion of the platinum loop, thus reducing the resistance of the entire circuit by exactly the necessary amount so that the diminished electro-motive force of the couple due to the rise of temperature of the cold end will send the same amount of current through the circuit and instrument, and consequently give the same reading as if there had been no change of temperature at the cold ends.

The compensator acts on precisely the same principle, but in a reverse manner, when the temperature falls at the cold ends, the resistance of the circuit being increased as the column of mercury lowers in the stem. The increase produced in the resistance of the circuit prevents the increased electro-motive force of the couple due to the fall of the temperature at the cold ends from sending an increased current through the instrument, therefore the reading remains unchanged. The compensator may also be employed within the indicating instrument to correct for atmospheric changes of temperature upon the instrument itself where extremely accurate results are required.

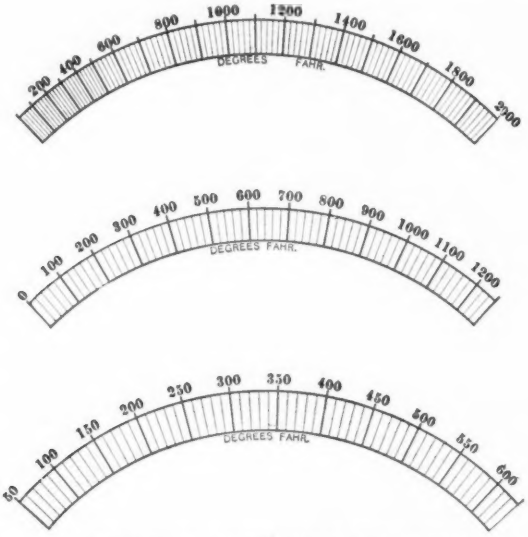


FIG. 5.—SCALES USED ON THERMO-ELECTRIC PYROMETER.

General Advantages of Thermo-Electric Pyrometers.

As compared with other forms of apparatus for measurement of high temperatures, the thermo-electric py-

rometer has many advantages, of which the following are the most important: They may be employed where the space is extremely small and inaccessible. They are practically independent of temperature variations intermediate of their hot and cold ends. They are independent of pressure and rough usage at the point where the temperature is desired to be measured.

The indicating instrument can be located at the most convenient point, practically at almost any distance from the couple. They are extremely sensitive to changes of temperature and respond instantaneously—that is, there is no lag error. They are constant in their indications when the couples are properly protected. They permit the determination of the temperature at many different points by means of several couples and leads connected to one instrument, provided with suitable switching device.

Special Advantages of Low Resistance System.

The important advantages of the low-resistance, thermo-electric pyrometer system may be summarized as follows: A commerical switchboard or portable dead-beat indicating instrument may be employed instead of the extremely delicate suspension galvanometer required for use with a single platinum-rhodium couple. It affords a practical method for automatically compensating for the changes of temperature at the cold ends of the couple, as already described. It makes it practicable to use the same indicating instrument and the same couple for different total ranges of temperature by using different binding posts and having several scales drawn, the proper resistances being inserted for each individual total scale. The application of low-priced metals and alloys as a substitute for platinum and rhodium makes it possible to install a number of couples, and by means of proper switching devices use an instrument for quickly determining the temperatures at the locations of the different couples. In many instances the first cost of the expensive platinum elements prohibit their use in this way.

Applications.

Many applications of this instrument will suggest themselves. A few of the important ones are mentioned, as, for example: in a boiler test where nineteen couples were simultaneously applied at different points between the furnace and the flue. From the data obtained a curve was drawn showing the temperatures at all points along the path of the products of combustion from the furnace to the flue, the abscissas corresponding to the square feet of heating surface, and the ordinates to degrees Fahrenheit. The value of such data for investigating and studying the economical working of steam power plants will be appreciated. The couple can readily be applied to the steam space of a boiler and used to show the degree of superheating.

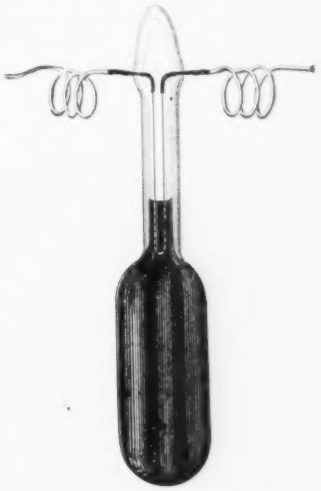


FIG. 6.—COMPENSATOR FOR THERMO-ELECTRIC PYROMETER.

These instruments have also been adapted to and are especially valuable in maintaining the desired temperatures for annealing, hardening, tempering and blueing of steel. When many small parts are handled, as in the manufacture of watches, a practical method of using the pyrometer is to adapt the pot containing the articles to the end of the couple and using it as a handle for inserting the pot into the furnace or into an ordinary forge fire. By revolving the pot it is heated perfectly uniformly, and as soon as the proper

temperature is reached it is shown on the indicator, and all guess work is eliminated.

They have been most successfully employed in lead-hardening baths. For this purpose the couples are protected by wrought iron pipes, and will last for months without renewal. After constant daily use for many weeks the couples give the same readings as when first installed.

In addition to making it possible to obtain absolutely uniform results with a given lot of steel it has been found that the life of the pots has been increased, as they are not overheated. From this fact it naturally follows there must be an economy of fuel as a result of using the pyrometer.

Application has also been made to galvanizing baths, affording means for keeping the molten metal at the proper temperature for the work, preventing overheating and wasting zinc by vaporization. They have been used to keep molten lead at correct temperature in the manufacture of shot.

These instruments have also been tried and are now being tested for indicating the temperature in the carbureter and superheater of a Lowe water-gas plant, where the process of gas making depends upon proper temperatures and the pyrometer shows when the steam and oil should be turned off and the blast turned on, and also when these operations should be reversed in order to obtain the most efficient results. By using two or three couples in the carbureter it is possible to adjust the spray of oil so that every part from center to shell will be working to the best advantage.

The instruments have also been successfully employed in chemical works.

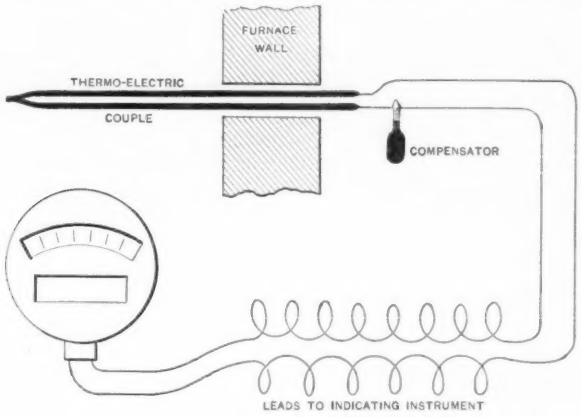


FIG. 7.—METHOD OF SETTING UP THERMO-ELECTRIC PYROMETER.

New Books.

"Practical Shop Work" in two volumes. Philadelphia. Historical Publishing Co. 1350 pages. Numerous illustrations. 6½ x 9½ inches. ¾ russia.

This work is in the nature of an encyclopedia and contains separate papers or treatises on machine shop work, machine drawing, tool making, milling machine, the gas engine, automobile construction, machine design, sheet metal work and foundry equipment. The work was carried on under the direction of Carl S. Dow, who was assisted by nine special writers, contributing papers upon various subjects. The work is intended as a handy reference book and as a general guide for those interested in these lines. The different divisions are quite complete in themselves, but there are many of the phases of shop work which are not treated as fully as we could wish to see them. We believe, however, that this work will find ready sale and fill a long felt want, particularly with apprentices, who are just entering the shop in various fields of work.

"Foundry Practice" by Tate & Stone. Published by H. W. Wilson Co., Minneapolis, Minn. Size 5½ inches x 8 inches, bound in cloth. 233 pages. Price $1.50.

This work was written by two practical men to serve as a text book in foundry practice at the University of Minnesota. The work has been revised and has now been adopted as a text book in a number of leading technical schools. The book, however, is of value in other fields also and should be found of interest especially to apprentices either to the molding or patternmaking trade and also to any person associated with the foundry trade, who desires to obtain a general knowledge of the subject.

Trade Publications.

A novel and interesting trade publication is being sent out by Wm. B. Scaife & Sons Co., of Pittsburg, Pa., manufacturer of water softening and purifying systems. Permission was secured to photograph two pages from the ledger of a prominent concern operating a 2,000-horsepower plant. The first account shows the expense of running the plant previous to the installation of the water softening equipment and the second statement shows the cost of running after the softening equipment had been installed. The saving was very much larger than even the designers had anticipated. The publication is gotten up in the shape of a folder and cut and printed to represent a ledger which opens to show the report. Copies of this will be sent to any one interested in the same.

Personal.

A. E. Hoermann, 41 Park Row, New York City, is distributing in the eastern states a catalog of the Pilling Air Engine Co., of Detroit, which company they represent. This catalog shows pneumatic motor hoists, pneumatic engines with various applications and also the pneumatic turn table device.

The editor notices that he failed to make mention in the May number of a publication received from the E. H. Mumford Co., Philadelphia, calling attention to the fact that the company had started April 1, 1905, and April 1, 1906, was in an exceedingly prosperous condition, having sold a large number of molding machines and having many more orders to fill.

The Phosphor-Bronze Smelting Co., Ltd., of Philadelphia, is sending out its 1906 price list, which is entitled *Price List No. 23.* This is in the form of a booklet 3½ x 6 inches, containing twenty pages and giving in addition to prices, etc., a number of very useful tables.

J. Neale Taylor, of the Union Foundry, Redfern, Sydney, Australia, is making a trip through the United States to study American foundry practice.

Fires.

The foundry of O'Brien Bros., Columbus, O., was seriously damaged by fire on April 25.

The plant of the Weatherly Foundry & Machine Co., Weatherly, Pa., was visited by fire on May 1, resulting in a loss of several thousand dollars, fully covered by insurance. A portion of the foundry building was saved and repairs will at once be commenced.

The foundry of Enz & Orr, Denver, Colo., was damaged by fire on April 14, and a number of valuable patterns were destroyed. The loss is estimated at $4,000.

The foundry of the Windsor Machine Co., of Windsor, Vt., was destroyed by fire on April 11, with a loss of $2,000, partly covered by insurance.

The foundry of the Aetna Foundry & Machine Co., of Springfield, Ill., was destroyed by fire on April 26; the loss is estimated at $10,000, partly covered by insurance. It is said the foundry will be rebuilt at once.

New Construction.

Clayton Bros., scissors manufacturers of Hartford, Conn., expect to equip a building near their present factory for use as a foundry and make their own iron castings in future.

The L. C. Roberts Mfg. Co., Fillmore, N. Y., recently incorporated to manufacture concrete mixers, is erecting a foun-

dry 44 x 52 feet and a machine shop 40 x 100 feet. The machinery will be electrically operated. The officers of the company are William P. Brooks, president; Wilson Young, vice president; Samuel G. McTarnachan, secretary; Carl J. Howden, treasurer, and Leonard C. Roberts, general superintendent.

The Pittsburg Steel Foundry Co. is constructing a large plant at Glassport, Pa., which will be used for the manufacture of car bolsters exclusively. Over $100,000 will be expended and it is expected that the plant will be completed within sixty days.

Work on the addition to the foundry of Knott, Harker & Co., of Beaver Falls, Pa., is progressing rapidly. The new building will be 65 x 86 feet, and will double their present capacity.

The pattern department of the Stanley G. Flagg foundry plant at Pottstown, Pa., will be enlarged by a fire-proof addition.

The American Car & Foundry Co. has purchased property at Bloomsburg, Pa., for making extensive additions to its plant.

The Grey Iron Foundry Co., Reading, Pa., has taken out a permit to erect a two-story galvanized iron foundry, 40 x 28 feet.

The Susquehanna Casting Co., of Wrightsville, Pa., will double the capacity of its foundry in the near future.

The new steel foundry to be built by the National Foundry Co., of Erie, Pa., includes a main building, 125 x 330 feet, of fire-proof steel construction, and a separate building for a power house, which will contain the boilers, engines, air compressor and electric generators for power and lighting. The entire plant will be equipped with all modern improvements and will represent an outlay of $150,000. Open-hearth steel castings and steel ingots will be manufactured. The officers of the company are E. D. Wetmore, Warren, Pa., president; J. P. Jefferson, Warren, Pa., secretary and treasurer; C. W. Davenport, of Erie, general manager; E. W. Sheldon, of Erie, assistant secretary and treasurer. Work on the plant will begin at once.

P. F. Jamieson and Jas. A. Norman are erecting a foundry at West Batavia, O., and will conduct a general foundry business. The building is 60 x 30 feet.

The Stirling Consolidated Boiler Co. is constructing a large foundry at Barberton, O., and making several other additions to its plant there.

The Wellston Foundry, of Wellston, O., has been closed down to allow several improvements to be made to the plant, including the installation of a large gas engine. Work will be resumed as soon as possible.

The Hill Clutch Co., of Cleveland, O., will erect a large foundry at its plant on Gordon avenue during the coming summer, at an expenditure of about $20,000. The site is already being prepared.

Plans are being prepared for an addition to the foundry of the Lunkenheimer Co., Cincinnati. The building and equipment will cost $200,000.

The W. S. Tyler Co., Wason street, Cleveland, has taken out a permit for a foundry addition to cost $800.

The Mahoning Pattern Co., of Youngstown, O., is constructing a new shop and will double its present force of employes.

The Aurora Foundry Co., Aurora, Ill., has completed repairs on the buildings recently destroyed by fire so that the plant is once more in operation. The construction of a large pattern house will soon begin on the site of the burned one. This will be two stories high, of fire proof construction.

The foundry of Gartland Bros., at Kankakee, Ill., is nearing completion and they expect to have it in operation early in June, beginning with a force of fifty men. This foundry was started by the Blue Flame Co., and purchased by Gartland Bros., who have foundries in Terre Haute and Marion, Ind.

The Berres Gehl Mfg. Co., West Bend, Wis., will rebuild its plant recently destroyed by fire, and plans have been drawn for a building 60 x 144 feet. The machine shop will be of the same size as the one destroyed, but the foundry will be nearly twice as large as the old one, the dimensions being 60 x 90 feet. The company expects to have part of the plant in operation by July 1.

The Kalamazoo Foundry Co., Kalamazoo, Mich., is planning to erect an addition to its foundry.

The Continental Gas Engine Works is planning to establish a foundry for the manufacture of steel, gray iron and aluminum castings, in connection with its new gas engine factory, at Menominee, Mich.

The New Winona Mfg. Co., of Winona, Minn., is erecting an addition to its foundry, 90 x 104 feet.

The addition to the plant of the Green Bay Foundry Co., Green Bay, Wis., is nearly completed and the company is preparing to manufacture stationary, marine and gasoline engines.

Anthony Reiser Jr. is enlarging his foundry at Wayne, Mich., and installing some new machinery.

The property formerly known as the Duke farm, in Harrison, N. J., has been sold to A. Shriver & Co., of New York, who propose to erect a large foundry for the manufacture of iron and brass castings. This firm formerly operated a foundry at East Fifty-sixth street, New York, which they have recently sold.

Work on the foundry of the Beggs Pipe & Foundry Co., of North Birmingham, Ala., has been started and the plant will be pushed forward as rapidly as possible.

The Wm. J. Oliver Mfg. Co., Knoxville, Tenn., now has its new foundry nearly completed. The foundry will have a floor space of 40,000 square feet and will be equipped with all modern appliances.

The Heron Iron Bedstead Co., of Chattanooga, Tenn., has taken out a permit for an addition to its foundry to cost $2,500.

The Norfolk & Western Ry. Co. will erect a foundry 144 x 740 feet at Roanoke, Va. L. E. Johnson, 398 Broadway, New York City, is president of the company.

The Downie-Wright Mfg. Co. has its new plant at Rapid City, S. D., well under way, the foundations for the machine shop and foundry having been laid, and the company expects to occupy these buildings in about six weeks. The machine shop will be 60 x 140 feet and the foundry 70 x 120 feet. Office, warehouse and pattern shops will be constructed later.

Watson & Fanering will build a foundry on Smelter Hill, Joplin, Mo.

The MacGregor-Gourlay Co., of Galt, Ont., has made plans for large additions to its plant, including molding and pattern departments, which will provide employment for from 150 to 200 men.

The Enterprise Foundry, of Sackville, N. B., has recently been enlarged and the company is now adding a new ware house and office building to the plant.

The Whiting Foundry Equipment Company has under way a number of important additions to its plant at Harvey, Ill., (suburb of Chicago). The extensions comprise a new pattern shop, 44 feet by 96 feet, and an addition, 52 feet x 130 feet, to the machine shop. The latter will give additional shipping facilities, permitting two tracks to cut through the shops and facilitating the loading of electric traveling cranes and equipment of heavy capacities. These improvements have been made necessary by the steadily increasing business which this company is handling.

The H. B. Smith Co., of Westfield, Mass., has decided to enlarge its north side plant and install considerable additional foundry equipment. The north side works are devoted to the making of radiators, while the south side foundry is devoted to the making of boilers and heaters, etc.

The plant of the H. K. Porter Co., of Pittsburg, is to be moved to Economy, Pa., where the company has secured a tract of 40 acres.

A contract has been let for the erection of the F. W. Wakefield Brass Works at Vermilion, O.

The Minster Machine Co., of Minster, O., has let a contract for the erection of a modern foundry building, 70 x 100 feet.

The Atha Steel Casting Co., Newark, N. J., which was recently organized to take over the business of the firm of Benjamin Atha & Co., is preparing plans for a steel and concrete building to be 200 feet square, and further extensions are contemplated which will practically double the present capacity of the plant.

The new plant of the Crown Pipe & Foundry Co., of Jackson, O., is

practically completed, and will be put in operation at once.

The Crawford & McCrimmon Co. of Brazil, Ind., has purchased land adjoining its plant for the erection of a foundry 170 x 54 feet.

The new plant of the Muncie Foundry & Machine Co., of Muncie, Ind., is completed, and that portion of the equipment from its old plant which is to be used is being installed, together with other machinery.

The Brass Foundry & Heating Co. of Peoria, Ill., has broken ground for the erection of a new brick foundry building 63 x 150 feet.

The stockholders of the Michigan Copper & Brass Co. of Detroit, Mich., expect to have their new plant in operation by Oct. 1 next. The site consists of twelve and a half acres of land east of Fort Wayne.

The new plant of the Grand Rapids Foundry Co. of Grand Rapids, Wis., has been completed and the machinery is being installed.

The Great Northern Road has decided to spend $500,000 in the enlargement of its plant at St. Paul, Minn., by the erection of a large foundry.

The Union Steam Pump Co., of Battle Creek, Mich., is making arrangements for another extensive addition to its plant, including changes in the foundry and pattern department.

The Neenah Brass Works of Neenah, Wis., is preparing to erect a large new foundry and machine shop.

It is stated that the United States Cast Iron Pipe & Foundry Co. will expend $100,000 in improving its plant at Bessemer, Ala. The improvement will include an addition of 150 feet to the main building, and the construction of another pit.

The Richmond Foundry & Mfg. Co., of Richmond, Va., is planning extensive additions to its plant.

The new foundry and machine shops of the Fisher Machine Works of Leavenworth, Kan., have been completed, the machinery from the old plant is being moved in, and new machinery installed.

The N. S. Sherman Machinery Co. of Oklahoma City, Okla., is negotiating for a site upon which to construct a large new plant.

Marion, Ind., interests have organized a company capitalized at $100,000 for the manufacture of stoves and ranges at that place. These interests include W. J. Swanger, S. D. McClain, J. Wood Wilson, C. C. Jamieson and others. Plans have been drawn for a foundry building 80 x 100 feet, main factory 50 x 200 feet, boiler, pattern and office buildings.

Following the recent increase of capitalization from $500,000 to $1,000,000, the Pittsburg Valve & Fittings Co. is planning additions which will practically double the size of its plant at Barberton, O. About 600 men are now employed, and the plant is already an extensive one.

The McFarland Foundry & Machine Co., northeast corner Maed street and Breunig avenue, Trenton, N. J., has been incorporated with a capital stock of $100,000, to manufacture gray iron castings, machinery, etc. The incorporators are: James J. Wilson, Louis C. Taylor, and Fred Mortimer Staples, all of the address given.

The Reynolds & Johnson Co., Hainesport, N. J., manufacturing plumbing materials, is to extend its foundry in the near future.

The Kennedy Valve Mfg. Co., New York, has acquired a site of about 20 acres at Elmira, N. Y., where it will erect a plant containing 100,000 square feet of improved steel and brick construction, electrically operated. The plant which will consist of iron and brass foundries, machine shops and other valve and hydrant building departments, will be located on the main line of the D. L. & W. railroad facilities. The work of removal from the present plant at Coxsackie, N. Y., will be gradual, so that operations will at no time be interfered with. Plans are now under way and F. C. Flinn, Chamber of Commerce, Elmira, N. Y., will be pleased to receive catalogs or information in the line of construction and equipment.

The Power & Mining Machinery Co., located at Cudahy, near Milwaukee, Wis., has under way improvements to its plant which involve an expenditure

of about $300,000. These include the erection of a 200-foot extension to its foundry building, which will be completed in June, and the construction of two new cranes, a new furnace and cupola, planing and rolling mill machinery and slotting machinery. The business of the company has outgrown its present facilities, and the capital was recently increased from $2,500,000 to $3,500,000. Benjamin Guggenheim, of New York, is president, and L. P. P. Seustman, of Milwaukee, first vice president.

The Champion Blower & Forge Co., Lancaster, Pa., has begun operation in its new foundry building, 70 x 360 feet, well equipped with cranes and three cupolas, having a capacity of 45 tons daily. The old foundry department is to serve as a machine and erecting shop. Practically all the equipment has been secured.

The Dennison Foundry & Engine Co., Dennison, O., is about to double the capacity of its plant to take care of its increased business.

J. B. Green, proprietor of the Des Moines Stove Repair Co., of Des Moines Iowa, has purchased some additional property upon which he will erect several new buildings, including a foundry, pattern shop, store room, etc.

H. A. Silver and J. J. Dayner Jr., have purchased a site of ground in Salt Lake City, Utah, upon which the H. A. Silver Machine & Foundry Co. expects to erect a new plant.

The Central Foundry Co., Muskegon, Mich., has been organized by Edward Mier to operate the old Davies plant in that city.

The Lena Foundry & Machine Co., of Lena, Wis., has a new plant under construction.

The Duluth (Minn.) Brass Works has secured a new site upon which it will erect a new plant, 50 x 125 feet.

The Union Pacific Railway Company is planning to erect a large new plant at Omaha, Neb., including foundry and other departments. It is stated that the entire equipment, including buildings, will cost at least $500,000.

The American Engineering Foundry Company will erect a pattern shop at 559 to 577 Mateo street, Los Angeles, Cal.

The S. B. Sexton Stove & Manufacturing Company, of Baltimore, Md., has awarded a contract to J. H. Miller for the construction of a foundry and warehouse. The foundry will be one story in height and 51 x 53 feet; the warehouse will be four stories and 30 x 40 feet.

The William J. Oliver Manufacturing Company, of Knoxville, Tenn., has secured the plant of the old Utica Desk factory and is having it remodeled as a foundry.

The Pascagoula Street Railway and Power Company, of Pascagoula, Miss., will build a new machine shop and foundry.

The United States Cast Iron Pipe and Foundry Company is moving its shops from Bridgeport, Ala., to Chattanooga, Tenn., and has secured a permit for additional buildings in connection with the Chattanooga plant.

The Casey-Hedges Company, of Chattanooga, Tenn., is planning to construct four new buildings, which will be 90 x 336 feet, 50 x 135 feet, 80 x 225 feet, and 60 x 200 feet. This company was incorporated with a capital of $900,000 to take over the plants of the Casey & Hedges Manufacturing Company and the Chattanooga Pipe & Foundry Company. M. M. Hedges is president and W. S. Todd, secretary.

The White Foundry & Machine Co., of Anniston, Ala., is erecting a new foundry building, 50 x 60 feet.

GENERAL INDUSTRIAL NOTES.

J. F. Mills, of Port Chester, N. Y., has purchased the plant of the Ideal Foundry Company, of Ashtabula, Ohio, and organized the Ashtabula Foundry Company, incorporated at $100,000.

The new foundry building of the Scott Iron Works at Reading, Pa., has been completed and the foundry department transferred to it. The old building, which has been occupied as a foundry since previous to the Civil war, will be modernized and added to

the machine shop. It was in this building that many of the cannon used in the Civil war were cast.

The Pennsylvania Foundry Co., organized to manufacture castings of brass, gray iron, etc., will commence operations in a short time in the building formerly occupied by the York Shoe Manufacturing Company, of York, Pa.

The idle plant of the Delaware River Steel Company, of Chester, Pa., will soon be operated by the Standard Steel Foundry Co., which has applied for a charter.

The William Kavanaugh Company will move its machine shop, gas and steam engine factory and foundry and pattern shop to Norwalk, Ohio. This will require the construction of several new buildings, including a foundry 50 x 150 feet. The departments were formerly located at Zelienople and Bruin, Pa., and at Sistersville, W. Va.

The plant of the National Valve Company, at Sandusky, Ohio, has been sold to E. M. Barnes, of Cleveland, and will be put in operation in the near future. The plant will be used for the manufacture of automobile parts and launch engines.

The Springfield Furnace Company, of Springfield, Ohio, has increased its capital stock from $10,000 to $20,000.

The Craig Foundry Company, of Toledo, Ohio, has filed notice of its dissolution and the sale of its franchises and buildings to the Toledo Shipbuilding Company.

The Batavia Engineering Works, of Batavia, Ill., has been incorporated with a capital of $50,000, to carry on a general foundry and machine shop. The incorporators are: Andrew Benson, Henry Benson and Albert Benson.

The American Brass Works, of Chicago, has been incorporated with a capital of $2,500, the incorporators being: Raymond H. Rudolph, Samuel McQuimm and John Burian.

The Artisan Brass Company is being organized in Chicago with a capital of $10,000. The incorporators are: Stanley W. Davis, J. Fitch Perkins and Robert F. Stockdale.

Carroll Brothers, the Houghton (Mich.) foundrymen, are installing electrical equipment for operating their plant. It is also stated that they will have a steel foundry in running order before summer.

The plant of Hoffman & Grimm, of Manitowoc, Wis., has been established in the building formerly occupied by the Seating Works and George Grimm. A new building was also erected and the necessary equipment for brass and iron foundries has been installed and the company expects to have its plant in operation before long.

The Kettler Brass Manufacturing Co. has amended its charter, changing its place of business from Dallas to Houston, Texas, and increasing its capital stock from $10,000 to $20,000.

The Pennsylvania Pneumatic Pump Co., with works and offices at Davenport, Iowa, is to move its plant to Binghamton, N. Y.

The Seattle Foundry Co., of Seattle, Wash., has been incorporated with a capital of $10,000, the incorporators being: Robert Niedergesaess, A. H. Garrison and William Dougall.

Hanson Brothers, owners of the Union Brass Foundry, of Georgetown, Wash., have sold their plant to be used for railroad right of way purposes, but they will secure another site in Georgetown and rebuild as soon as possible.

The Carondelet Foundry Co., of St. Louis, Mo., has increased its capital stock from $75,000 to $125,000.

The Barlow Foundry Co., of Newark, N. J., has been incorporated with a capital of $250,000.

The Industrial Foundry & Machine Works has been organized at Knoxville, Tenn., and will use the old building on Jacksboro street formerly used by the car works. This company succeeds the Knoxville Metal Bed Manufacturing Co., but will not engage in the manufacture of metal beds, as the work will be confined to a general foundry and repair business.

The Novelty Foundry & Machine Works, of Nashville, Tenn., which was incorporated recently with a capital

of $35,000, has elected the following officers and directors: L. M. Shepherd, President; Verner M. Jones, vice president; J. A. Burton, secretary and treasurer, and Thos. O. Perkins, general manager. These with E. H. Roy, A. P. Foster, E. S. Shannon and L. D. Love will consitute the board of directors.

The Decatur Car Wheel & Manufacturing Co., of Birmingham, Ala., has secured a site on which to erect a plant with a capacity of 200 wheels per day. W. J. Morrison is president.

William Russell, of Spartanburg, S. C., is to establish a foundry and machine works.

It is reported that L. A. Pangle, of Concord, N. C., is planning to erect a foundry and machine shop.

Fair, Taylor & Co., dealers in foundry supplies at San Francisco, Cal., inform us that they were burned out in the great fire and have opened new offices at 657 Webster street, Oakland, Cal., and are once more ready to transact business.

The foundry formerly operated in connection with the Portsmouth Foundry & Machine Co. is now offered for sale by Simon Labold, of Portsmouth, O.

The Boston Art Metal Co., of 95 Bird street, Dorchester, Mass., has leased the building formerly occupied by the American Brass Foundry, at Hyde Park, Mass., and will begin operating its new plant early in June.

The Briggs Iron Works, recently started at Springfield, Mass., has been consolidated with the Springfield Iron Foundry, of the same city, and its equipment moved to the plant of the latter company. The Springfield Iron Foundry is planning to start a brass foundry in the plant formerly occupied by the Briggs Iron Works.

The Nonpareil Brass Co. has bought the plant of the Joseph Pickup Brass Foundry, of Providence, R. I.

The brass foundry of the N. B. Dodge Mfg. Co., of E. Hampden, Mass., has been closed.

The offices of Matthew Addy & Co., dealers in pig iron and steel, have been moved from 15 Cortlandt street to 39-41 Cortlandt street, New York.

The Lehighton Foundry & Machine Co. is moving its plant from Lehighton, Pa., to Weissport, Pa., where it will occupy the old Lehigh Valley Emery Wheel plant, and expects to be in operation with an increased force within a few months.

The Catasauqua Castings Co. has purchased the property formerly operated by the Union Foundry & Machine Co., Catasauqua, Pa., and the plant will be put in operation at once. The capital stock of the new company is $50,000 and the stockholders are Leonard Peckitt and Richard O. Kohler, of Catasauqua, and A. W. Findlay, of Wayne.

The Brighton Alloy Mfg. Co., of Cincinnati, O., manufacturer of alloys for use in the cupola and in the ladle, has found it necessary to remove to larger quarters to take care of its growing business and is now located at 1233 Harrison avenue, Cincinnati.

The plant of the Falls Rivet & Machine Co., of Cuyahoga Falls, O., was visited by fire recently, but the company informs us that the department manufacturing the Wadsworth core machine and core coning machine, etc., was not injured, and hence the manufacture of this machinery will not be interfered with in any way. This is very fortunate, as the company has a large number of orders on its books.

The Hamilton Foundry & Machine Co., Hamilton, O., has increased its capital stock to $150,000 and plans have been made for additions to the plant which will double its capacity. Work on two new buildings will begin at once and the number of employes will soon be largely increased.

The Aluminum & Brass Castings Novelty Co., of Toledo, O., has been incorporated by Bert B. Decker, E. R. Rowe, C. A. Potter, V. J. Waltz and S. D. Waltz. Capital stock, $10,000.

The Portsmouth Stove Foundry Co., Portsmouth, O., has its foundry in operation and is filling orders, though only ten weeks have passed since the plant was damaged by fire.

Thomas L. Wayne, for several years superintendent of the Blymer foundry

in Cincinnati, has taken a half interest in the Troy Foundry, of Troy, O., and has assumed the business management of the plant. The business of the Troy Foundry has been increasing since it began operations a few months ago, and improvements to the plant are now being planned.

The Kokomo Brass & Plumbing Co. has been incorporated at Kokomo, Ind., and will erect a foundry for the manufacture of aluminum castings. The officers of the new company are: Chas. T. Byrne, of Chicago, president; James F. Ryan, of Chicago, vice president; J. W. Johnson, of Kokomo, treasurer and general manager.

The Mandt & Powell Concrete Machinery & Foundry Co., Stoughton, Wis., has been incorporated by M. G. Mandt, G. G. Mandt and John Evans, with a capital stock of $24,000.

The James J. Lacy Co., Baltimore, Md., has been incorporated with a capital stock of $50,000 to manufacture all kinds of iron and steel castings. The incorporators are James J. Lacy, Joseph J. Lacy, Wm. G. V. Hull, Thomas W. Ryan and D. Meredith Reese.

The Wyland-Newman Machine Co., Greensboro, N. C., has been incorporated with a capital stock of $100,000, and the contract has already been let for the necessary buildings, including a foundry, for the manufacture of iron and wood working machinery. Mr. George C. Wyland, formerly of Williamsport, Pa., is president and manager, and George F. Newman, of Greensboro, will be secretary and treasurer.

The Roemer-Worrick Machine Co. has been incorporated with $2,000 capital stock by Charles Roemer, Emile Roemer and J. H. Worrick, at Bowling Green, Ky. The company has purchased and will operate the Heminger foundry.

The new plant of the Bristol Stove & Foundry Co., of Bristol, Tenn., is now in operation. This company was recently organized by G. C. Harris and he has associated with him the George Bros., who have closed their foundry in South Bristol. A general foundry business will be conducted in addition to the manufacture of stoves.

The Asheville Supply & Foundry Co., Asheville, N. C., which lately increased its capital stock to $25,000, will enlarge the capacity of its foundry soon.

The stockholders of the Clay Center Windmill & Foundry Co., Clay Center, Kan., have elected the following officers: President, S. E. Keener; vice president, F. L. Williamson; secretary, W. A. Munson; treasurer, F. H. Myers. The capital stock of the company is $25,000, and it is probable that a larger foundry plant will be constructed soon, as its present quarters are too small for its increasing business.

The Middle West Brass Foundry of Webb City, Mo., has been incorporated with $5,000 capital stock by Frank A. Hamilton, John L. Klopfenstein and W. G. Bryant.

The Enterprise Brass Foundry, of Seattle, Wash., has been incorporated by Frank L. Baker, Eugene Thurlow and John Carey, with $6,000 capital stock.

E. P. Dove has purchased the interest of L. Staples in the machine shop and foundry of Staples æ McKinnon, of Winlock, Wash., and the firm name is now Dove & McKinnon.

The Medina Iron & Brass Mfg. Co., Medina, N. Y., has been incorporated by Edward L. Sturgis, manager of the Central foundry at Medina, Fred T, Gates, Isaac S. Signor, and Jesse Landauer. For the present the company will locate in the old Bromley foundry at Albion, N. Y., and will manufacture soil pipe and brass and iron fittings.

The Meyer Foundry & Machine Co., South Bend, Ind., has been incorporated for $30,000 by Henry J. Meyer, Edward DeKezel and R. B. McInerny. It has acquired the plant of the Anderson Plow Works, a large well equipped structure, and will manufacture plows and hardware specialties and operate a foundry and machine shop.

The Astona Foundry Co., has been chartered to carry on iron and steel work. The capital stock is $115,000, and the incorporators are: Walter H. Storm, Maywood, N. J.; George S. Andrews, No. 155 Norwood avenue, Brooklyn; and Chester J. Storm, Maywood, N. J.

The American Valve Co. has been incorporated with a capital stock of $150,000 to manufacture valves, etc. The incorporators are: George Green, Owen L. Whiteman, and E. R. Hotaling, all of Coxsackie, N. Y.

The Charlotte Pipe & Foundry Co., Charlotte, N. C., which recently sustained a considerable loss by fire, is re-established in a temporary building and is now operating its soil pipe plant on regular time. Only about 10 days were lost on account of the fire. It is the intention of the company, within the near future, to replace the temporary building with a steel frame structure with galvanized roofing and siding. W. F. Dowd is president and treasurer.

The Gorham Mfg. Co., Providence, R. I., is planning additions to its sand foundry which will double its capacity. The building with the addition will be 90 x 204 feet, of steel and reinforced concrete construction. A traveling crane and other equipment will be installed.

The Crescent Foundry Co., Des Moines, Ia., has been organized with a capital stock of $25,000 to take over the plant of the Purington Mfg. Co. The incorporators are: H. R. Hewell, W. V. Wilcox and W. B. Starkey.

The Wilson Stove Mfg. Co., St. Louis, Mo., has been incorporated with a capital of $500,000. The incorporators are: James Wilson, James B. Wilson and Stephen B. Long.

The firm of Ammons & Goan has been established at Knoxville, Tenn., by John T. Ammons, M. A. Ammons and others, who will operate a stove foundry costing $10,000.

The Virginia Pipe & Foundry Co., Richmond, Va., has been organized with $50,000 capital stock with Thomas S. Speelwright as president, and W. R. Wayt, secretary and treasurer. The McClintic-Marshall Construction Co. has the contract for a steel building 125 x 150 feet for this company, which will manufacture cast iron soil pipe.

The North American Steel Co., Belington, W. Va., has been incorporated with $1,250,000 capital stock by Grant C. Groomall, Harvey Hatch, C. R. Rusk, of Belington; Sam M. Nease, of Weston, W. Va., and David A. Nease, of St. Louis, Mo.

The Jones & Hopkins Mfg. Co., Nashville, Tenn., has increased its capitalization from $50,000 to $100,000, and will erect a foundry building 90 x 185 feet.

Ballou's White Sand Co. has been organized, with a capital stock of $10,000, to develop a 25-acre deposit of white sand at Millington, Ills., and will begin shipping about April 20.

The Whitehall Contracting Co., New York, has been incorporated to carry on a brass foundry and manufacture engines, machinery, etc. The capital stock is $5,000 and the incorporators are: Stacy R. Hills, No. 266 84th street, Brooklyn; Thomas L. Rolls, No. 23 South Arlington avenue, East Orange, N. J.; John W. Dunn, No. 123 Liberty street, New York.

The Vulcan Iron Works, Seattle, Wash., is planning the erection of an extensive plant for the manufacture of mining and other machinery supplies and engines and boilers. The plant will include machine shops, foundry, pattern shops, forge shops, rolling mills, etc. A large amount of new machinery will be required. H. P. Strickland is secretary and treasurer.

The New Phoenix Foundry & Machine Co., Springfield, Mo., now has under way four new structures, each 50 x 70 feet, a foundry, machine shop, blacksmith shop and boiler shop. Considerable new equipment will be purchased.

The Bellaire Stove Co., Bellaire, O., is shortly to erect a foundry 80 x 100 feet.

The Challingsworth Foundry & Machine Co., Mt. Vernon, O., has completed its foundry and installed electric cranes with complete equipment. The plant is in charge of H. C. Challingsworth, who, for the past six years, has been in charge of the foundry of C. & G. Cooper Co., engine builders of Mt. Vernon.

The foundry which the Deere & Mansur Co., Moline, Ill., is soon to erect will be 80 x 182 feet in addition to an extension of the present foundry. Track and cars for charging the cup-

olas will be purchased. The company is also planning to increase its present blacksmith shop, punch room and steel storage shop. G. W. Crampton is secretary.

Plans have been completed for additions to the plant of the Union Malleable Iron Co., East Moline, Ill. These will include an extension to the foundry and annealing department and the installation of new engines and dynamos.

The new foundry of Frazer & Jones Co., Syracuse, N. Y., is to be of steel construction and modern in every respect, though some details, particularly those relating to power, have not yet been settled. The usual foundry equipments will be installed.

The Detroit Steel Casting Co., Detroit, Mich., has decided to add another furnace to its plant and to increase its main building from 100 to 150 feet.

The St. Charles Car Works, the largest branch of the American Car & Foundry Co., will erect a $250,000 steel plant in St. Louis, Mo., which will employ 500 men. James Lalor, manager of the St. Charles company, obtained the necessary concessions for the use of streets, alleys, etc., from the St. Charles city council a few days ago, and the work of erecting the building will begin at once.

The St. Paul Foundry Co., St. Paul, Minn., has practically completed an addition, 80 x 115 feet, to its structural steel shop for which all equipment has been secured.

The Odin Stove Mfg. Co., Erie, Pa., has completed plans for a new foundry, 55 x 165 feet, with other small additions to its present plant.

The National Cast Steel Co., Avonmore, Pa., has been absorbed by the Avonmore Cast Steel Co., and it is stated the plant at that place will be put in operation in the near future. Officers of the Avonmore company have been chosen as follows: J. R. Silvis, Uniontown, Pa., president; John P. Conn, Uniontown, vice president; A. Granville, Pittsburg, treasurer; John S. Douglass, Ewing A. Hibbs, Jacob A. Bear and L. H. Frasher, all of Uniontown; M. V. Patterson, Saltsburg and J. S. Strahn, Avonmore, additional directors.

The Jos. Wood & Sons Foundry and Machine Co., of Marine City, Mich., has been sold to Alex R. Sinclair, Geo. W. Cook and Wm. H. Cook. The name will be changed to the Marine City Engine & Boiler Works.

The Walker Foundry Co. of Jersey City, N. J., has been incorporated to manufacture electric machinery, with a capital stock of $100,000, and the incorporators are: Joseph Diehl Fackenthal, John J. Daly and Albert C. Wall.

In the February issue of THE FOUNDRY we published an item concerning the American Brake Shoe & Foundry Co., of Mahwah, N. J., and since that date have received a letter from them stating that the item is likely to give a false impression. The company has not placed an additional $1,000,000 mortgage on its properties, but filed a supplemental mortgage to include in the original and only mortgage some properties secured since the original mortgage was issued. The total mortgage now stands at $924,000 and is being reduced each year by the sinking fund.

The Anniston Foundry & Machine Co., Anniston, Ala., has increased its capital stock from $25,000 to $30,000.

The Piedmont Supply & Foundry Co., of Asheville, N. C., has been incorporated with authorized capital of $10,000, $4,000 of which is subscribed for. The incorporators are: Wm. Farr, C. H. Hopkins, David Kimberly and W. H. Clark, all of Asheville.

The Dayton Pneumatic Tool Co. has opened a branch office in the Lincoln Trust Bldg., St. Louis, Mo. Mr. J. A. Prescott, southwestern manager, is in charge.

The Lufkin Foundry & Machine Co., of Lufkin, Tex., has increased its capital stock from $30,000 to $60,000.

The Enos Foundry Co., of Waterloo, Iowa, has been sold to Mr. J. C. Barnes of Leavenworth, Kan., and Mr. Barnes has moved his family to Waterloo, so as to take direct charge of the business.

The Miners' Foundry Co., of Nevada City, Cal., has been incorporated with a capital of $50,000, the incorporators being: W. H. Martin, B. J. Hall, J. G. O'Neill, W. R. Martin and Miss May C. Martin.

The Kucera Windmill, Machine & Foundry Co., of Grand Island, Neb., has been incorporated with an authorized capital of $50,000, $10,000 of which is paid up. The incorporators are: R. Homalka, E. Rohla, G. L. Kucera, J. Kucera and G. Kucera.

Mr. J. C. McDonald, proprietor of the new steel plant at Grand Forks, B. C., has been given a cash bonus of $600, and free power for one year at Grand Forks.

The Richland Foundry Co., of Belleville, Ill., has increased its capital stock from $6,000 to $25,000.

The new brass foundries of the Wabash railroad, which have recently been moved from Mobile and Decatur, Ill., to Springfield, Ill., are now in working order.

Pawling & Harnischfeger, who have extensive works at Milwaukee, Wis., for building traveling cranes and hoists, have established an office at No. 45 Broadway, New York City, and appointed William F. Brewster as manager.

The New Bedford Boiler & Machine Company, of New Bedford, Mass., has purchased the brass foundry of R. M. Gardner & Co., of that city, and is building a new foundry building, 35 x 60 feet.

The B. B. Potter Co. has been established at Griffith, Ind. (Chicago suburb) to manufacture machinery, hardware, farm implements, and other specialties, and to do a general foundry business. B. B. Potter, secretary and treasurer of the North Star Iron Works at Hammond, Ind., is owner and manager of the plant, and John Helfere, superintendent.

The foundry of the Manual Training Department in the Illinois State Reformatory at Pontiac, Ill., was put in operation on April 14, when the first heat was taken off successfully, under the direction of Mr. A. L. Patch, who has charge of the work. The castings made in the department are for the use of the schools.

The Chicago Hardware Fdy. Co., of Waukegan, Ill., is to erect a foundry building 65 x 100 feet at a cost of $12,000.

The Coosa Pipe & Fdy. Co., Gadsden, Ala., is to erect an additional pipe foundry building 80 x 200 feet. Ten pipe floors are now operating, seven more will be added March 1, and three more June 1. The present daily capacity of 20 tons of finished product will be increased to 40 tons by May and probably to 100 tons by the close of the year.

The Rolen Foundry & Mfg. Co., Manhattan, N. Y., has been incorporated to manufacture brass finishings, brass goods, etc., with a capital of $2,500. The directors are: H. W. A. Lehnert, George J. Rohman, and Andrew Lehnert, Brooklyn.

The North Lebanon Foundry Co., Lebanon, Pa., has been incorporated with a capital stock of $10,000. The incorporators: Samuel P. Rank, A. Wesley Patchkin, John H. Walborn, Elmer P. Kreider, John C. Brightbill, of Lancaster, and Samuel Gingrich, of Harrisburg.

The Elwood Heater Co., Elwood, Ind., has been incorporated to make stoves, heaters, furnaces, etc., and run a general foundry. The capital stock is $50,000 and the incorporators are: Daniel Spicher, L. D. Miller and Geo. Fahl.

The Clapp-Reynolds Foundry Co., Middletown, O., has been incorporated with $20,000 capital stock by W. W. Reynolds, H. J. Clapp, E. M. Reynolds, C. F. Clapp and R. J. Kaser.

The Warren Co., Camden, N. J., has been incorporated to conduct a general mechanical engineering, brass founding and metal working business. The capital stock is $125,000 and the incorporators are: John A. MacPeak, Geo. H. B. Matrin and F. R. Hansell, all of Camden.

Ed Rohla, of Milligan, Neb., will open a foundry in Grand Island, Neb.

The Green Bay Foundry & Machine Co., Green Bay, Wis., has acquired the plant and will succeed to the business of

the Western Steel Gate Co. John J. Arvey, H. L. Indra and E. P. Miller, constitute the new firm.

The Elizabethport Brass Fdry. Co. now has its foundry at Elizabeth, N. J., in running order with a capacity of about 2,000 pounds per day. Frank J. Freund is president and Charles F. Hinde, secretary and treasurer.

The Quincy Enameling & Foundry Co., Quincy, Ill., has been incorporated with a capital of $4,000 to do a general foundry business. The incorporators are: John M. Mintro, Louis H. Menne and William H. Covert.

The Topton Foundry & Machine Co., Topton, Pa., has been organized with a capital of $15,000 to engage in the manufacture of steel and iron castings, etc. The incorporators are: Howard S. Christman and John Hartley of Topton, and B. Frank Harpel of Bernville.

The Arcade Mfg. Co., Freeport, Ill., is to add a brass foundry 50 x 80 feet and a gray iron foundry 65 x 200 feet. It is planned to have these in operation by July 1.

The Steel Foundry Co., Cincinnati, has the work of constructing its new plant well under way, and is now purchasing equipment. The monthly capacity will be 5,000 tons, and the plant will be in operation shortly after May 1.

Work has been begun on the new plant of the Bucyrus Steel Castings Co., Bucyrus, O., and it is expected will be completed by fall.

The Lynchburg Foundry Co., Lynchburg, Va., has additions under way which will increase its capacity about 20 per cent.

The Merrimac Iron Foundry, Lawrence, Mass., is preparing plans for a new plant. This will consist of a foundry building, 100 x 200 feet, with two cupolas and traveling cranes, a cleaning and shipping building, 75 x 100 feet, a storage building and power house. The construction and equipment of the plant are in charge of Arthur F. Gray, 509 Exchange building, Boston.

The Niagara Falls Brass Works, Buffalo, N. Y., has been organized to manufacture metals and metallic compounds. The capital stock is $6,000, and the incorporators are: William R. Pooley, John J. Crumlish and J. Noble Frantz, all of Buffalo.

The Colorado Gray Iron Co., Denver, Colo., has incorporated to build a foundry costing about $100,000 in that city. Those interested are J. M. Herbert and Tyson Dines, both of Denver, and C. T. Lowndes and C. L. Tutt of Colorado Springs. Mr. Herbert will be president and treasurer of the company.

The De Soto Fdy. & Machine Co., Mansfield, La., has been incorporated for $30,000 with Frank Kavanaugh and J. C. Perkins of Lufkin, Tex., as president and secretary-treasurer. A large building will be erected.

Contracts have been let for the rebuilding of the core rooms and lower foundry of the United States Radiator Works, Dunkirk, N. Y., recently destroyed by fire. The new structure will be double the size of that destroyed, being 102 x 375 feet.

The Lattimer-Williams Mfg. Co., Columbus, O., has increased its capital stock to $200,000, and will complete extensive improvements in the near future. One of the largest foundry structures in the city is now being erected. Allen W. Williams is secretary and manager.

The Ensign Foundry Co., Toledo, O., has completed a large addition to its present plant which it is about to equip for the manufacture of soil pipe and fittings.

The Malleable Iron Works, Marion, Ind., has completed plans by which it will materially increase its capacity. Manager J. C. Haswell has signed a contract with the factory committee of Marion under which the company agrees to employ not less than 600 men for a period of five years. The new buildings to be erected include a foundry 112 x 125 feet, with a wing 30 x 100 feet, two new shipping rooms 90 x 120 and 60 x 80 feet, and a new office and pattern store house building 80 x 80 feet. The plant at present employs about 275 men.

The Victor Foundry Co., Hamilton, O., has been incorporated with a capital of $25,000 by Harry V. Moore, Gustav Sauer, Sigmund Sauer, Charles Muller and Morris Sauer.

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Alphabetical Index to Advertisers.

Adams Co..... 21, 140
Addy, Matthew, & Co..... 146
Ajax Metal Co..... 136
Albany and North River Moulding Sand Co..... 132
American Air Compressor Works..... 145
American Blower Co..... 111
Arcade Mfg. Co..... 22
Atlas Car & Mfg. Co..... 131
Baird & West..... 147
Barnett, Oscar, Foundry Co..... 36
Bartlett, N. S., & Co..... 146
Berkshire Mfg. Co..... 20
Blackwell, Geo. G., Sons & Co..... 137
Blake, Geo. F., Mfg. Co..... *
Brandau, Adam..... 143
Brass Founders' Supply Co..... 140
Bridgeport Safety Emery Wheel Co..... 123
Bristol Co..... 141
Brown Specialty Machinery Co..... 25
Buffalo Foundry Supply Co..... 6
Burdick & Son..... 141
***Byram & Co**..... *
Carborundum Co..... 125
Case Mfg. Co..... 130
Caufman, S. H..... 141
Channon, H., Co..... 143
Cherry Valley Iron Co..... 44
Chicago Pneumatic Tool Co..... 139
Clark Cast Steel Cement Co..... 34
Columbus Iron & Steel Co..... 146
Connersville Blower Co..... Back cover
Cornell, J. B. & J. M., Co..... 142
Crescent Phosphorized Metal Co..... 136
Crossley Mfg. Co., The..... 143
Curtis & Co. Mfg. Co..... 39
Dalton, Nash & Co..... 146
Dayton Pneumatic Tool Co..... 139
Deane Steam Pump Co..... 149
DeCamp Bros. & Yule Iron, Coal & Coke Co..... 146
Diamond Clamp & Flask Co..... 143
Dimmick, J. K., & Co..... 146
Dings Electro Magnetic Separator Co..... 134
Dixon, Joseph, Crucible Co..... 42
Dobson, William..... 123
Dodge & Day..... 145
Domhoff & Joyce Co..... 146
Dresden Sand Company..... 144
Drucklieb, C..... 125
Elm City Engineering Co..... 135
Etting, Edward J..... 144
Fair, Taylor & Co..... 145
Falls Rivet & Machine Co..... 23
Fanner Mfg. Co..... 141
Field, Alfred & Co..... 138
Field, Robt, Sales Agency..... 147
Fox Machine Co..... 131
Gautier, J. H., & Co..... 46
General Pneumatic Tool Co..... 129
Gilmer, L. H. & Co..... 119
Gilmour, J..... 135
Goldschmidt Thermit Co..... 35
Goodrich, F. A., & Co..... 146
Gray, B. M..... 147
Gregg Company..... 130
Gunn, Richards & Co..... 121
Hanna Engineering Works..... 43
Harbison-Walker Refractories Co..... 144
Hawley Down Draft Furnace Co..... 28
Herman Pneumatic Machine Co..... 18, 19
Hill & Griffith Co..... 5
Hillman, J. H., & Son..... 146
Holland Linseed Oil Co..... 51
Hooper, G. K..... 145
Ingersoll-Rand Co..... 37
Jones & Attwood..... 144
Keep, W. J..... 145
Kendall & Flick..... 136
***Kent Mfg. Co**..... *
Kilbourne & Jacobs Mfg. Co..... 140
Leavitt, C. W. & Co..... 137
Lindsay, W. W., & Co..... 16, 17
MacKellar's Sons Co..... 143
Macphail Molding Machine Co..... 24
Manning, Maxwell & Moore..... 128
Maris Bros..... 127
Maurer, Henry & Son..... 144
McCormick, J. S., Co..... 9
McCullough-Dalzell Crucible Co..... 48
McKeefrey & Co..... 146
Metallurgical Laboratory..... 145
Mfg. Equipment and Engineering Co..... 123
Midvale Mining & Mfg. Co..... 137
Millett Core Oven Co..... 27
Mills, C. E., Oil Co..... 50
Mohr, J. J..... 146
Monarch Engineering & Mfg. Co..... 29
Mumford, E. H. Co..... 12, 13
National Jeloluse Co..... 138
New Era Mfg. Co..... 137
Niles-Bement-Pond Co..... 127
Northern Engineering Works..... 128, 130
Norton Emery Wheel Co..... 117
Norwalk Iron Works Co..... 149
Obermayer, S., Co..... Inside front cover
Osborn Mfg. Co..... 119
Otis Steel Co..... 135
Pangborn, T. W. Co..... 8
Partamol Co..... 142
Pawling & Harnischfeger..... 129
Paxson, J. W., Co..... 2, 3, 4
***Pettinos Bros**..... *
Phosphor Bronze Smelting Co..... 136
Pickands, Brown & Co..... 147
Pickands, Mather & Co..... 147
Pike Manufacturing Co..... 119
Pilling & Crane..... 147
Piqua Flour Co..... 111
Piqua Foundry & Machine Co..... 133
Pridmore, Henry E..... 10, 11
Ransom Mfg. Co..... 125
Republic Iron & Steel Co..... 45
Ridgway, Craig, & Son Co..... 40
Robeson Process Co..... 1
Rockwell Engineering Co..... 132
Roessler & Hasslacher Chemical Co..... 137
Rogers, Brown & Co..... 147, 148
Roots, P. H. & F. M., Co..... Insert
Ross-Tacony Crucible Co..... 49
Sellers, Wm., & Co..... 31
Shelton Metallic Filler Co..... 32
Shepard, Chas. G..... 147
Shuster, F. B., Co..... 139
Sly, W. W., Mfg. Co..... 30
Smith, J. D., Foundry Supply Co..... 7
Smith & Caffrey Co..... 131
Smooth-On Mfg. Co..... 33
Standard Sand & Machine Co..... 134
Sterling Oil Co..... 138
Stevens, F. B..... 113, 115, 147
Stow Mfg. Co..... 117
Sturtevant, B. F., Co..... 38
Tabor Mfg. Co..... 14, 15, 138
Taylor, Robert J., Inc..... 47
Thomas Furnace Co..... 147
Tilghman-Brooksbank Sand Blast Co..... 123
Turner Machine Co..... 133
Turner, Vaughn & Taylor Co..... 26
U. S. Chaplet Co..... 141
Vitrified Wheel Co..... 117
Walter-Wallingford & Co..... 147
Waterbury Crucible Co..... 142
Western Foundry Supply Co..... 142
Whiting Foundry Equipment Co..... 52
Yale & Towne Co..... 129

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Monarch Engineering & Mfg. Co., Baltimore.
Roots Company, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

Blowers—Positive Pressure:
Connersville Blower Co., Connersville, Ind.
Piqua Foundry & Mch. Co., Piqua, O.
Roots Company, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

Brushes:
Osborn Mfg. Co., Cleveland.

Burners (Oil):
Monarch Engineering & Mfg. Co., Baltimore.

Carbonese:
Midvale Mining & Mfg. Co., E. St. Louis, Ill.

Castings (Steel):
Otis Steel Co., Ltd., Cleveland.

Cement (Furnace):
Dixon Crucible Co., Jos., Jersey City.
Gautier & Co., J. H., Jersey City.

Cement (Metallic):
Clark Cast Steel Cement Co., Shelton, Conn.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Chaplets:
Burdick & Son, Albany.
Fanner Mfg. Co., Cleveland.
Lindsay & Co., W. W., Philadelphia.
U. S. Chaplet Co., New York.

Coke:
Gray, B. M., New York.
Rogers, Brown & Co., Cincinnati.

Cores:
Brown Specialty Machry. Co., Chicago.

Core Binders:
Holland Linseed Oil Co., Chicago.
Millers' Products Co., Chicago.
Mills Oil Co., C. E., Syracuse.
National Jeloluse Co., New York.
Robeson Process Co., Camden, N. J.
Sterling Oil Co., Emlenton, Pa.

Core Machines:
Brown Specialty Machry. Co., Chicago.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Jones & Atwood, Stourbridge, Eng.
Kent Mfg. Co., Kent, O.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

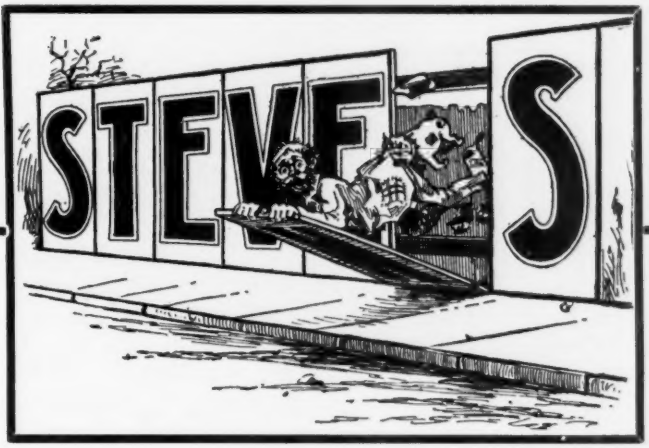
Core Tapering Machines:
Brown Specialty-Machinery Co., Chicago.

Core Ovens:
Atlas Car & Mfg. Co., Cleveland.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Millett Core Oven Co., Brightwood, Mass.
Paxson Co., J. W., Philadelphia.
Pangborn Thos. W. Co., New York.
Smith Foundry Supply Co., J. D., Cleveland.

Core Oven Recording Thermometer:
Bristol Co., Waterbury.

Cranes:
Case Mfg. Co., Columbus, O.
Curtis & Co. Mfg. Co., St. Louis, Ill.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia.
Niles-Bement Pond Co., New York.
Northern Engrng. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Ridgway & Son, Craig, Coatesville, Pa.
Sellers & Co., William, Inc., Philadelphia.
Whiting Foundry & Equipment Co., Harvey, Ill.

Continued on page 116



The Missing Letter

All the advertisements in this edition are in a way advertising my warehouse stock of Foundry Supplies. I carry them all—or nearly all—you can have quicker service and at just as low a price by buying them from me.

POLISHERS' AND PLATERS' SUPPLIES

I manufacture an entire line of polishing compositions—Tripoli, Crocus, Rouge, etc. These compositions are, from a practical point of view, the very best now on the market. The term "best" is a relative adjective, of course, and I use it in just that way, meaning that there is nothing so good offered today. If you will send that missing letter I will prove this statement.

BRASS FOUNDERS' SUPPLIES

There are several missing letters in my mail from Brass Founders who are in a hurry for supplies or who are not entirely satisfied with their present stock. Mail the letter and I will do the rest.

FREDERIC B. STEVENS

Corner Third and Larned Streets

DETROIT, MICH.

Crushers and Pulverizers:
Moussette, O. J., Brooklyn.

Crucibles:
Dixon Crucible Co., Jos., Jersey City.
Fair, Taylor & Co., San Francisco.
Gautier & Co., J. H., Jersey City.
McCullough-Dalzell Crucible Co., Pittsburg.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Ross-Tacony Crucible Co., Philadelphia.
Taylor, Robt. J., Inc., Philadelphia.
Waterbury Crucible Co., Waterbury.

Cupolas:
Byram & Co., Detroit.
Gilmour, J., New York.
McCormick Co., J. S., Pittsburg.
Northern Engnrng Works, Detroit.
Paxson Co., J. W., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Linings:
McCormick Co., J. S., Pittsburg.
Paxson Co., J. W., Philadelphia.

Elevators:
Curtis & Co. Mfg. Co., St. Louis.
Ridgway & Son, Craig, Coatesville, Pa.

Engines (Gas):
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

Engines (Steam):
American Blower Co., Detroit.
Sturtevant Co., B. F., Boston.

Engineers (Foundry, Mech., Elec., &c.):
Dodge & Day, Philadelphia.
Hooper, Geo. K., New York City.

Facings:
Buffalo Foundry Supply Co., Buffalo.
Dixon Crucible Co., Jos., Jersey City.
Hill & Griffith Co., Cincinnati.
R. MacKellar's Sons Co., Peekskill, N. Y.
McCormick Co., J. S., Pittsburg.
Obermayer Co., S., Cincinnati.
Paxson Co., J. W., Philadelphia.
Smith Foundry Supply Co., J. D., Cleveland.
Stevens, F. B., Detroit.
Western Foundry Supply Co., E. St. Louis, Ill.

Fans:
American Blower Co., Detroit.

Ferro-Manganese:
Kendall & Flick, Washington, D. C.
Rogers, Brown & Co., Cincinnati.

Ferro-Silicon:
Raessler & Hasslacher Chemical Co., New York.
Rogers, Brown & Co., Cincinnati.

Fillers (Metallic):
Clark Cast Steel Cement Co., Shelton, Conn.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Fire Brick:
Gautier & Co., J. H., Jersey City.
Maurer & Son, Henry, New York.

Fire Sand:
Carborundum Co., Niagara Falls, N. Y.

Flasks:
Adams Co., Dubuque, Ia.
Barnett Fdy. Co., Oscar, Newark.
Brass Founders' Supply Co., Newark.

Flasks (Snap):
Adams Co., Dubuque, Ia.
Diamond Clamp & Flask Co., Richmond, Ind.
Obermayer Co., S., Cincinnati.
Smith & Caffrey Co., Syracuse, N. Y.

Flour:
Millers' Products Co., Chicago.
Piqua Flour Co., Piqua, O.

Foundry Equipment (Iron & Brass):
Barnett Fdy. Co., Oscar, Newark.
Etting, Edward J., Philadelphia.
Obermayer Co., S., Cincinnati.
Pangborn, Thos. W. Co., New York.
Sly, W. W. Mfg. Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

Foundry Supplies:
Buffalo Fdy. Supply Co., Buffalo.
Caufman, S. H., Chester, Pa.
Fair, Taylor & Co., San Francisco.
Hill & Griffith Co., Cincinnati.
McCormick Co., J. S., Pittsburg.
Obermayer Co., S., Cincinnati.
Osborn Mfg. Co., Cleveland.
Pangborn, Thos. W. Co., New York.
Paxson Co., J. W., Philadelphia.
Smith Foundry Supply Co., J. D., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

Furnaces (Melting):
Barnett Foundry Co., Oscar, Newark, N. J.
Hawley Down Draft Furnace Co., Chicago.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Rockwell Engineering Co., New York.

Grinding Machinery:
Adams Co., Dubuque, Ia.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Norton Emery Wheel Co., Worcester.
Ransom Mfg. Co., Oshkosh, Wis.

Grinding Wheels:
Norton Emery Wheel Co., Worcester.
Pike Mfg. Co., Pike, N. H.
Vitrified Wheel Co., Westfield, Mass.

Grinding Pans:
Crossley Mfg. Co., Trenton, N. J.

Hammers (Pneumatic Chipping):
Ingersoll-Rand Co., New York.

Continued on page 118